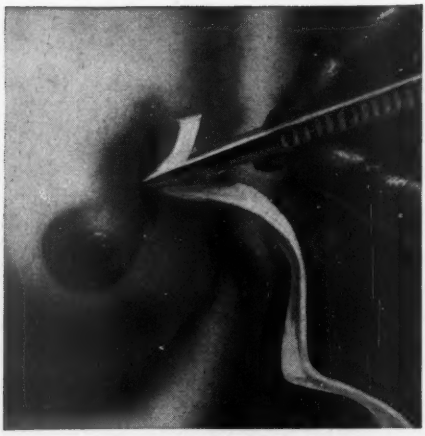
VOLUME 19 May, 1953 NUMBER 5

THE AMERICAN SURGEON

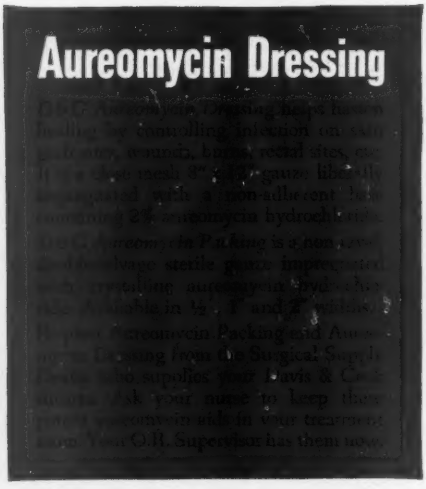
PUBLISHED MONTHLY BY
THE WILLIAMS & WILKINS COMPANY
BALTIMORE 2, MARYLAND

Latest clinical report[1] demonstrates D&G

Aureomycin Packing is "far superior"



Breast abscess packed with Aureomycin Packing after incision and drainage.



Now available—new film
"Aureomycin to Combat Local Infection"
—send requests to D & G Film Library

Recent investigators[1] state: "Aureomycin Packing is far superior to iodoform gauze, plain gauze or any other type of gauze packing known to us." They used it in abscesses and wound infections in which a variety of organisms was present. Plain sterile packing and iodoform packing were used as controls.

High, prolonged antibacterial action. After 16 hours, 65.4% of the aureomycin had been utilized, and after 48 hours, 93.3%. D&G Aureomycin Packing helps heal infected wounds *otherwise inaccessible to systemic antibiotics* because of thrombosed blood vessels and a total decrease in blood flow. "Foul odor was considerably reduced."[1]

No interference with healing. "Aureomycin and plain packing showed no impairment of growth of cells in tissue culture . . . . Iodoform showed decreased growth."[1]

Relatively non-toxic. "No significant local or systemic toxic effects were noted, nor was allergy or local skin irritation in evidence."[1]

[1]Marchisello, P. J., Prigot, Aaron, and Wright, L. T.: Am. Jour. Surg., Dec., 1952.

Davis & Geck, Inc.

A UNIT OF AMERICAN *Cyanamid* COMPANY

57 Willoughby Street, Brooklyn 1, N.Y.

Entered at the Post Office in Baltimore, Maryland as second-class matter.

CONTENTS, MAY

THE
AMERICAN
SURGEON

Vol. 19, No. 5 May, 1953

BLEEDING AS A COMPLICATION OF DIVERTICULOSIS OR DIVERTICULITIS OF THE COLON*

WILLIAM C. QUINN, M.D. AND ALTON OCHSNER, M.D.

New Orleans, La.

As a result of numerous studies, it is very well known that at least 5 per cent of all people over 40 years of age have diverticulosis, and that this condition is relatively uncommon before this age. When diverticula are present in the colon, but are not inflamed, the condition is called diverticulosis. When the sacs are involved in an inflammatory process, the disease is known as diverticulitis. Approximately 15 per cent of all persons having diverticulosis will subsequently develop diverticulitis. Fortunately, most of these cases can be controlled medically.

The etiology of diverticulosis so far is unknown. The generally accepted explanation for its presence is that it appears when the muscular tone of the bowel wall decreases in the middle and older age groups in an area where intraluminary pressure is great. Pressure is naturally greater in the sigmoid colon because in that region the diameter of the colon becomes relatively small and feces are more solid than in the proximal portion of the large bowel. As would be expected, the sigmoid and descending colon are affected in over 90 per cent of all cases of diverticulosis or diverticulitis. Diverticula usually occur in the taeniae near the mesenteric border, where the blood vessels and lymphatics enter the colon. Since diverticula lie so close to these vessels, severe bleeding, as a complication, is quite understandable. Diverticulitis itself is thought to result from inflammation caused by incarcerated feces within one or more diverticula. The area of inflammation may be so localized that the typical spasm

* From the Department of Surgery, Tulane University of Louisiana School of Medicine, New Orleans, La.

Presented during the Louisville Assembly of The Southeastern Surgical Congress, Louisville, Kentucky, March 9–12, 1953.

or saw-tooth appearance of the colon is absent on the roentgenogram. Many patients with bleeding demonstrate on roentgenograms only the picture of diverticulosis.

In some textbooks bleeding as a complication of diverticulosis or diverticulitis is mentioned as a rare complication, and in others it is not mentioned at all. Mayo and Blunt[1] found hemorrhage to be a complication in 8 per cent of the patients admitted to the Mayo Clinic because of diverticulitis or diverticulosis. In Morton's[2] series, it occurred as a complication in 20 per cent of cases. Our belief that bleeding as a complication of these conditions is increasingly becoming a major problem has led to the present study and discussion.

The first question usually asked is, how can it be determined that bleeding is the result of involvement of one or more of these diverticula? Actually, the diagnosis can usually be made only by a process of elimination. We have estab-

TABLE I

Complications requiring hospital admission in 76 cases of diverticulitis (diverticulosis)

Complications	Cases	Per cent
Hemorrhage	37	48.7
Obstruction	15	19.7
Abscess	8	10.5
Local inflammatory process		
sigmoid	6	7.9
cecum	5	6.6
Acute perforation	3	3.9
Fecal fistula (abdominal)	2	2.6

lished the following criteria, which we believe when fulfilled justify the assumption that the bleeding is from the diverticula:

1. The passage by rectum of gross blood, either bright or maroon in color.
2. Barium enema evidence of diverticulitis or diverticulosis.
3. Absence of other intrinsic lesions on rectal or proctoscopic examination.
4. Roentgenographic studies demonstrating the stomach and small bowel to be normal.

During the past 10 years (Table I) 76 patients have been admitted to Charity Hospital of Louisiana in New Orleans because of complications resulting from diverticulitis or diverticulosis of the colon. Thirty-seven of these (48.7 per cent) were admitted primarily because of hemorrhage. In 23 of the 37 cases (62 per cent) hemorrhage was considered massive. These patients either were admitted in shock or were found to have a hematocrit of 30 or less. In 14 cases the hemorrhage was classified as moderate. The average age of this group was 66 years, as compared to the average age of 61 years for the entire group with complications of diverticula of the colon requiring admission. There was no significant difference in age between those admitted with massive hemorrhage and those admitted with moderate hemorrhage, or in those who required operation for bleeding. In the entire group with complications, in patients admitted primarily because of bleeding, the ratio of females to males was 2 to 1.

In a few of our cases, pathologic study of the surgically removed specimen or autopsy studies definitely proved the bleeding to have occurred from the diverticula. We have discarded from the series 18 possible cases for several reasons. In one group the studies were incomplete, lacking, for instance, upper gastrointestinal roentgenograms or proctoscopic examinations. In another group we were unable to eliminate hemorrhoids as a possible source of the bleeding. In still another group we discarded those cases in which the blood passed was tarry and not red, realizing, even though the upper gastrointestinal roentgenograms were negative, that such changed blood was more apt to have the upper gastrointestinal tract as its source than the colon.

TREATMENT OF HEMORRHAGE

The majority of patients responded to conservative measures to control their bleeding (Table II). These consisted of rest, sedation, transfusions, and, in some instances, intestinal antiseptics. They were subsequently instructed to adhere to a bland diet and to avoid constipation. One patient died in the hospital

TABLE II

Methods of management in 37 cases of hemorrhage in diverticulitis (diverticulosis)

Method	Cases
Conservative therapy	30
Satisfactory results	25
Died in hospital	1
Recurrent hemorrhage	4
Surgical therapy	7
Recurrent hemorrhage	4
Uncontrolled hemorrhage (emergency)	1
Inability to distinguish from carcinoma	2

while being treated conservatively, death resulting directly from uncontrolled hemorrhage. This case will be discussed later (Case 1). Of those patients whom we have been able to follow after their discharge from the hospital, 4 have progressed poorly. They have had recurrent bleeding but have refused operation, or their general condition was such that surgery was considered inadvisable. Four patients have been readmitted because of recurrent severe bleeding, and resection of varying areas of the left colon has been done on each of these. In 2 of these left hemicolectomy was the operative procedure. Preoperative studies, as well as examination of the bowel at operation, failed to indicate the bleeding point. Uninflamed diverticula were noted throughout the entire colon but, as was to be expected, they were more numerous in the left half. In the other 2 patients readmitted because of recurrent severe hemorrhage, a segmental resection of the sigmoid and descending colon was done as there was evidence of mild diverticulitis in these areas. In 2 additional patients, surgery was performed because the possibility of a carcinoma as a source of the hemorrhage could not be excluded. In one, an exploratory laparotomy alone was necessary; in the other a left hemicolectomy was done. In a seventh patient total colectomy was per-

formed as an emergency procedure because of uncontrolled massive bleeding (Case 2).

CASE REPORTS

Case 1. A. D., a 59 year old colored woman was admitted to the Charity Hospital in February 1951 with evidence of a left cerebral hemorrhage and passage of tarry stools by rectum. There was evidence of a sigmoido-abdominocutaneous fistula, which had been present since the incision and drainage of an abdominal abscess 40 years previously. The hematocrit on admission was 25. A barium enema demonstrated diverticula of the sigmoid and descending colon but there was no evidence of inflammation. Other studies, including gastrointestinal series and proctoscopic examination were negative. The patient responded to conservative measures and was discharged on the nineteenth hospital day with instructions to continue with a bland diet and mineral oil. She was readmitted in shock six months later, with a history of passage of large quantities of dark red blood from the rectum for one day. She had also noted some passage of dark red blood by way of the abdominal fistula. Notwithstanding multiple transfusions, totaling 3,500 cc. of whole blood, the patient died in shock on the third hospital day. Autopsy revealed diverticulitis of the sigmoid as the only source of the gastrointestinal bleeding.

Case 2. A. B. a 79 year old colored man, was admitted to the Charity Hospital on Sept. 7, 1951, with a history of repeated passage of bright red blood from the rectum for one day. Physical examination was essentially negative except for bright red blood on rectal examination. The hematocrit was 17. The patient was transfused repeatedly but continued to pass bloody stools. Therefore, it was deemed necessary to try to localize the site of the bleeding. Proctoscopic examination revealed no intrinsic lesion. A barium enema demonstrated diverticulosis of the entire colon. An upper gastrointestinal series revealed a questionable prepyloric ulcer. Because the patient continued to suffer from uncontrolled bleeding, an exploratory laparotomy and gastrostomy were performed on the nineteenth hospital day. No source of bleeding could be found in the duodenum and stomach. The abdomen was closed without further surgery. Because the patient continued to pass bloody stools and to demonstrate evidence of uncontrolled bleeding, an exploratory operation was done two days later. At this time his stomach was again opened, and separate openings were made in the upper and lower small intestine, but no blood was found in any of these viscera. A total colectomy with anastomosis of the ileum to the rectum was then done. Bloody stools ceased but the patient died on the third postoperative day without ever rallying completely from the operative procedure. Altogether, he was given 20 pints of blood during his hospital stay. Pathologic study of the removed colon demonstrated it to be filled with old and fresh blood, with diffuse diverticulosis. The exact site of the bleeding could not be determined. Subsequent autopsy revealed no further evidence of intestinal bleeding. Death was attributed to shock from blood loss and operative trauma.

SURGICAL RESULTS

Elective surgery for hemorrhage was performed on 6 patients. Exploratory laparotomy was done in 1, segmental resection of the left colon in 2, and left hemicolectomy in 3 (Table III). There was 1 postoperative death resulting from a massive pulmonary embolus in a patient subjected to left hemicolectomy. The other 5 have done well and have had no recurrent bleeding. All surgical procedures were done in one stage. A seventh patient died in shock following a total colectomy as an emergency procedure because of uncontrolled bleeding. This patient had diverticulosis throughout the colon but it was impossible to determine the location of the bleeding point. Because over 90 per cent of the complications of diverticulitis occur in the left half of the colon, perhaps left hemicolectomy would have been sufficient in this case. Certainly it would have been a less traumatic procedure. Bleeding as a complication of diverticulitis or diverticulosis of the right half of the colon is probably uncommon and we do not believe it occurred in any of our cases.

TABLE III

Results of surgery in 7 cases of bleeding in diverticulitis (diverticulosis)

Method	Cases
Left hemicolectomy	3
Partial resection left colon	2
Exploratory laparotomy	1
Death (pulmonary embolus)	1
Apparent cure	5
Total colectomy	1
Death (shock)	1

In patients requiring surgery because of bleeding, the inflammatory reaction of the bowel is frequently minimal or absent, and it is usually possible to do the resection and anastomosis in one stage. Diverticula are frequently present in the remaining portion of the colon, or subsequently develop, but complications resulting from them did not occur in our patients on whom surgery was done for bleeding, and occurred only occasionally when surgery was done for other complications of diverticulitis. The removal of the most involved areas of the intestines and the increased fluidity of the stools are possible explanations.

SUMMARY AND CONCLUSIONS

Hemorrhage is not an uncommon complication of diverticulosis or diverticulitis of the colon. It occurred in 37 of 76 of a series of complications of these diseases requiring hospital admission.

In the majority of patients, bleeding can be controlled by conservative measures, *i.e.*, transfusions, rest, sedation, antibiotics, and subsequent bland or low residue diet.

In patients with recurrent hemorrhages, with uncontrolled bleeding, or in

cases in which carcinoma cannot be excluded as a cause of the bleeding, surgery may be necessary.

In our hands, segmental resections or left hemicolectomies, when the site of the bleeding point cannot be determined, have given satisfactory results in eradicating bleeding and in preventing its recurrence. Such operative procedures can usually be done in one stage.

REFERENCES

Mayo, C. W., and Blunt, C. P.: Symposium on abdominal surgery; surgical management of complications of diverticulitis of large intestine, S. Clin. North America, *30:* 1005 (Aug.) 1950.

Morton, J. J., Jr.: Diverticulitis of colon, Ann. Surg. *124:* 725 (Oct.) 1946.

TANTALUM GAUZE IN THE PRESENCE OF INFECTION: CLINICAL EXPERIENCE*

AMOS R. KOONTZ, M.D.

Baltimore, Maryland

It is evident from questions asked at various meetings that there is considerable misconception about the way tantalum gauze and tantalum in general behave in the presence of infection. While it is very generally known that persistent sinus tracts do not result when infection occurs around certain metals, such as tantalum wire[14] and stainless steel wire[1], a great many people are puzzled as to what to do when infection occurs in the presence of tantalum gauze. It may be said at the outset that infection around tantalum does not cause extrusion of the material and does not cause a persistent sinus tract, or any trouble whatsoever, unless there is some other nonabsorbable foreign body present with the tantalum. A tantalum plate, for instance, in the skull does not cause trouble in the presence of infection unless osteomyelitis of the skull ensues, in which case the sequestrum has to be removed but not necessarily the tantalum plate.[4, 15] Likewise when infection occurs around implanted tantalum gauze (most frequently used for hernia repair), it does not cause trouble (such as a persistent sinus tract) unless silk or cotton has been used as ligatures or sutures in the wound. If these materials have been used, then the offending sutures or ligatures must be removed before the sinus tract will close.

It is the purpose of this paper to produce the evidence—both experimental and clinical—for the statements made in the preceding paragraph.

Experimental Evidence. Koontz and Kimberly[5] have shown that neither tantalum gauze nor tantalum wire causes trouble in the presence of infection, provided that neither silk nor cotton is used in the infected wound. These authors produced muscle and fascia defects in the abdominal walls of dogs and purposely infected the wounds. The defects were repaired with tantalum gauze using tantalum wire as suture material. Catgut was used as ligatures. Notwithstanding the gross infection the wounds healed nicely and the resulting repair of the abdominal wall was just as strong as if no infection had occurred. In none of the cases was there a persistent sinus tract.

The effect of infection in similar experiments when tantalum gauze was sutured in place with silk, however, was quite a different story. Such infected wounds invariably resulted in either a persistent sinus tract leading down to a silk suture or in a buried infected granuloma surrounding a silk suture.

As braided tantalum wire is a very useful material, and does not cut through like monofilament wire when used for suturing soft parts, it was believed that it was essential to determine how it would behave in the presence of infection.

* From the Departments of Surgery of the Johns Hopkins University School of Medicine and the Johns Hopkins Hospital.

Read during the annual meeting of The Southeastern Surgical Congress held in Louisville, Kentucky, March 9–12, 1953.

It was necessary to consider the possibility that the interstices in the braided wire might serve as harboring places for niduses of bacteria and thus keep up infection. Experiments however proved that this was not the case, and that wounds healed nicely without residual sinus tracts, notwithstanding having been grossly infected in the presence of braided tantalum wire.

Clinical Cases. As a result of these experiments, which showed the little trouble caused by tantalum in the presence of infection and the good healing and excellent repair obtained notwithstanding gross infection, I did not hesitate to operate upon several patients with potential infections. The first case was that of a large man (267 lbs.) who had had a cholecystectomy following by a wound disruption. The disruption was closed, but resulted in a hernia. The hernia was repaired later but it promptly recurred. When I first saw this patient, he had a huge pendulous hernia with some excoriations of the skin over the pendulous part of the hernia. Although I kept him in the hospital two months before operation in an effort to get the excoriations of the skin to heal, the effort was unsuccessful. I decided to operate upon him anyway, realizing that his wound would almost certainly become infected. At operation I found the defect to extend from the costal margin to 1 fingerbreadth above Poupart's ligament and to be 6 inches wide. Silk was used to close the peritoneum (braided tantalum wire would now be used), as ligatures and to close the subcutaneous tissue. A piece of tantalum gauze 6 by 12 inches was used to close the fascial defect. Gross infection of the wound occurred and pus exuded from the wound for a couple of weeks, resulting in several sinus tracts from which silk ligatures were expelled. Finally all of the sinus tracts closed except one and this persisted for 10 months. Then a final piece of silk was removed from the wound, following which the sinus tract closed. The hernia was perfectly cured and the patient had no further trouble.

The second case was also that of a hernia in a cholecystectomy wound in a large fat man. He had had an abscess in the hernial area several weeks prior to the time I operated upon him. Had I not been confident that tantalum would cause no trouble in the presence of infection, I would not have dared to operate upon him so soon after he had had a gross infection in the operative site. Following operation, his wound did become grossly infected, but the infection promptly cleared up, and his hernia was perfectly cured.

The third case was that of an 82 year old man who had had a Miles operation with a midline colostomy five years previously. He developed an enormous postoperative hernia with his colostomy opening in the center of the hernia. It was obvious that any operative procedure in this area would have a good chance of becoming infected. A few weeks prior to repairing the hernia, the colostomy opening was moved as far laterwards as possible. At the time the hernia repair was done, tantalum wire was used to close the fascia and this suture line was reinforced with a piece of tantalum gauze. Catgut was used as ligatures. The wound healed per primam and resulted in a cure of his hernia.

Other cases which were not originally or potentially infected became infected

during the period of convalescence, but in no case did the infection result in extrusion of the tantalum or prevent a cure of the hernia. This has been true of both ventral and inguinal hernias.

A very interesting and instructive case was that of a moderately stout woman who was referred to me by another surgeon who had operated upon her more than a year previously for a large ventral hernia, using tantalum gauze in the repair and concomitant cotton sutures and ligatures. The wound had become grossly infected and a sinus tract had persisted until the time she was seen by me. The hernia however was completely cured. I injected the sinus tract with methylene blue and then opened the wound. It was found that the methylene blue had spread out in a wide area subcutanesouly over a large part of the abdominal wall. The methylene blue stained the cotton sutures and ligatures so that they could be readily identified and removed. Following removal of all the cotton, the wound promptly closed and has remained healed. The hernia has also remained cured. Other surgeons have mentioned similar cases to me and have considered the possibility of removing the tantalum gauze. This case and those mentioned above show conclusively that it is not necessary to remove the tantalum gauze, and that only the offending silk or cotton sutures should be removed. In fact, it would be next to impossible to remove the gauze in any case, so firmly has it become infiltrated and surrounded by fibrous tissue.[6] Lam[10], in one of his early cases, thought it necessary to remove the tantalum gauze because of infection. He found this very difficult to do because of the growth of connective tissue through the meshes of the screen. He also pointed out that in future cases he would hesitate to remove the screen because the tantalum did not seem to form a nidus of suppuration.

Some surgeons seem to be afraid of tantalum in the presence of infection and their first reaction, when infection occurs, is to take the tantalum out. The main object of this paper is to attempt to dispel this fallacious reasoning. Leave the tantalum alone and take out the other offending material, such as silk or cotton, and then the wound will heal. Some surgeons seem to believe that the quantity of the foreign material is a deterrent to healing. In several cases I have used a piece of tantalum gauze 12 by 12 inches, covering practically the entire abdominal wall, and there was no difficulty with healing. One of these cases became badly infected, but the wound healed nicely with a cure of the hernia. It cannot be too strongly stressed that in the presence of infection, leave the tantalum alone but do whatever else is necessary to secure healing.

Other authors have reported similar results. Ruggiero[12] reported three wound infections following the use of tantalum wire and mesh, two of which were superficial and the third deep enough to expose part of the mesh. All of the wounds healed and the hernias were cured in all instances.

Crile and King[3] reported a case in which the left half of the abdominal wall had been invaded by carcinoma of the colon and was involved by a necrotic mass of cancer and a fecal fistula. A section of the abdominal wall measuring 12 by 15 cm. was removed and was replaced by suturing in a piece of tantalum gauze

12 by 15 cm. The skin was undermined and closed over it. Good healing ensued notwithstanding the contamination. Six months later the abdominal wall was firm.

Healing by Granulation When the Tantalum Becomes Exposed. One of my early cases was that of an unusually fat woman with a huge ventral hernia (figs. 1 and 2). Her panniculus was 6 inches thick. About a week after operation she developed an area of necrosis in the skin and fat about 2 inches in diameter which was due to the wide dissection of skin flaps and poor circulation. This area of necrosis was cut away with scissors. After cutting it away, a deep hole resembling a well was left in the skin and fat, which led down to the exposed

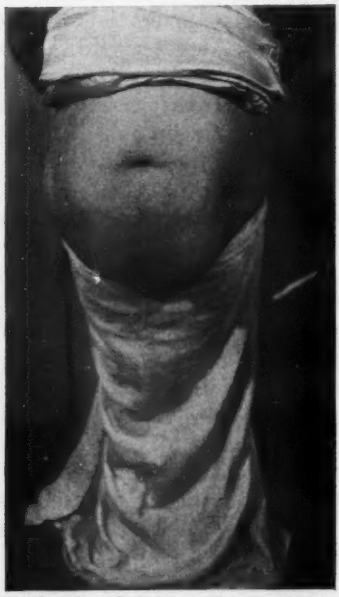


FIG. 1. Huge woman who developed an area of necrosis in the skin and subcutaneous tissue following wide dissection of skin flaps and implantation of tantalum gauze. The necrotic tissue was cut away. Granulations grew through the meshes of the gauze and spontaneous healing ensued.

tantalum gauze. Efforts to close this wound resulted in complete failure because the fat had practically no fibrous tissue in it, and it was like trying to place sutures in soft butter. After a period of time granulation tissue could be seen growing through the meshes of the tantalum gauze. In due course of time the wound healed by second intention and the hernia remained cured.

Wright[16] has reported a similar case in which there was sloughing of the skin and subcutaneous tissue resulting in complete exposure of an area of the implanted tantalum gauze. In his case also granulation tissue grew through the meshes of the gauze and healing by second intention occurred without too much delay.

Bussabarger, Dumouchel, and Ivy[2] reported a case in which a large part of the abdominal wall in the right lower quadrant was invaded by carcinoma of the cecum. The abdominal wall was resected and the defect repaired by suturing a piece of tantalum gauze to the fascial edges. The skin defect could not be completely closed but granulations eventually grew through the meshes of the gauze and the wound healed.

The Importance of Subcutaneous Tissue. It has been pointed out previously that the skin covering tantalum gauze should have subcutaneous tissue under it to act as a buffer between the tantalum and the skin proper. When wounds

FIG. 2. Same patient as that shown in Figure 1, side view

become infected, sometimes this subcutaneous buffer is lost, due to the infection, and some subsequent revision of the wound may be necessary. The following case illustrates this point: a huge fat man was operated upon for a postoperative hernia in a gallbladder incision. A few months before I operated upon him he had had an abscess in the operative site. Therefore, I was prepared for his wound to become infected from any organisms that might still be lurking in that vicinity. The wound did become grossly infected but promptly healed and the operation resulted in a cure of the hernia. About a year after operation the patient complained of soreness in his wound. Examination showed that a ridge in the tantalum gauze (fig. 3) was irritating the skin. (The infection in the patient's wound immediately after operation had caused the loss of the subcutaneous

tissue in that area although the skin flaps used when the wound was closed had plenty of subcutaneous tissue in them.) An elliptical incision was made around the reddened skin area. The skin was excised. The ridge in the tantalum gauze was cut away with scissors. The skin edges in the surrounding area were undermined and the wound was again closed, this time again using skin that had plenty of subcutaneous tissue under it. Following the second closure the patient

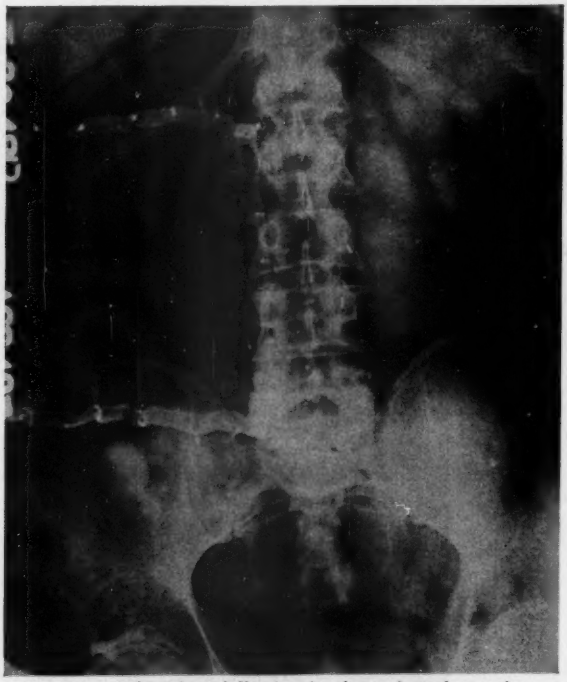


FIG. 3. Roentgenogram of patient following implantation of tantalum gauze for repair of a hernia in a gallbladder incision. This patient had had an infection in the operative site prior to the operation for hernia and consequently his wound became grossly infected. Although he was a fat man and had plenty of subcutaneous tissue with which to cover the tantalum, due to the infection the subcutaneous fat in the center of the wound sloughed out. This left the skin, immediately over the wrinkle shown in the middle of the piece of tantalum, without a protective buffer of subcutaneous tissue. The wrinkle against the skin caused some redness and irritation. About a year after the hernia repair the small area of skin which was devoid of subcutaneous tissue was excised, the ridge in the tantalum gauze was clipped off, the skin edges were undermined, and skin with plenty of subcutaneous tissue under it was brought together over the tantalum. There was no further trouble.

had no more trouble. As he had no infection at the time of his second operation, he lost no more subcutaneous tissue so there was no reason for him to have any further trouble.

Handling of Potentially Infected Wounds. Every surgeon who has had to deal with many large hernias has had cases in which he believed that there was a great chance of the wound becoming infected because of the nature of the skin

through which he had to operate. Often the skin is pendulous and has many creases, wrinkles, and crevices which are impossible to prepare for surgery in anything like an adequate aseptic fashion. In such cases I suggest the following procedure:

1. Closure of peritoneum with braided tantalum wire.
2. Use of tantalum gauze, sutured in place with monofilament tantalum wire to close the fascial defect.
3. Use of fine chromic catgut for ligatures.
4. Use of silk to close the subcutaneous tissue.

In huge ventral hernias the sac is, as a rule, not composed simply of peritoneum, but of peritoneum reinforced by fibrous tissue and scar tissue. Instead of excising the entire sac, flaps can be fashioned out of the sac and these flaps can be overlapped, suturing the edge of one flap of sac to the fascial edge on the opposite side, and overlapping it with the other flap of sac, suturing the edge of the second flap to the edge of the fascia from which the first flap originated. I prefer continuous sutures of braided tantalum wire (size no. 0, 0.015 inch) for suturing these flaps in place, because braided tantalum wire does not tend to cut through as does monofilament wire. Also it gives no trouble in the presence of infection, like silk does.[5] The reason for using continuous sutures is that they leave less chinks and crevices in the suture line than interrupted sutures, through which omentum may protrude to form the beginning of another hernia. Continuous sutures, however, do have the disadvantage that, if a knot becomes untied, the entire suture line is subjected to hazard. These sutures should not be cut *on the knot*. The ends should be left at least 2 millimeters long, as has been so ably pointed out by Price.[12] The continuous sutures may be stayed and reinforced by placing interrupted sutures around them at convenient intervals. The fascial defect may then be closed by a piece of tantalum gauze sutured in place with monofilament tantalum wire (size no. 3–0, 0.010 inch), according to the method described in previous communications.[6, 7, 8] Fine chromic catgut is preferred for ligatures because it does not leave as wet a wound as plain catgut does, and, should infection ensue, it causes no trouble.

My reason for using silk in the subcutaneous tissue instead of catgut is that, in case of infection, the catgut will readily dissolve and allow separation of the wound, while if silk is used it holds the wound edges together until the infection clears up and thus prevents separation of the wound. In 2 cases the separation of the wound edges caused considerable inconvenience. In both of these cases I used catgut in the subcutaneous tissue. Infection ensued and the wound edges separated exposing the tantalum gauze. This caused considerable delay in healing. It was necessary for granulations to grow through the tantalum gauze and for healing to take place by second intention, whereas had silk sutures been used in the wound the edges would have been held together until primary healing of the skin took place, thus preventing exposure of the tantalum gauze and delayed healing. Had a sinus tract persisted due to subcutaneous silk sutures in these instances, it could have been easily treated by removing the offending sutures.

It is realized that criticism might justly be directed at me for advocating the use of silk and catgut in the same wound. Meleney[11] has shown that infection occurs much more frequently in wounds in which catgut and silk are used together than in those in which either is used by itself. He has also shown that the least number of infections occur in those wounds in which silk alone is used. I advocate the use of the two materials together only in those wounds in which there is some possibility that infection might occur. In such wounds it would certainly be more logical to use fine wire as ligatures and sutures than either silk or catgut. Both tantalum and stainless steel wire have been shown to be more desirable in the presence of infection than either of the other two materials.[1, 14] I believe that tantalum wire would be preferable to stainless steel wire because of the slight undesirability of using two different metals in the same wound.[5, 9] My reason for not having used this is that it has not been available until recently.

Drains. In all cases in which extensive dissection of skin flaps is necessary for the implantation of large pieces of tantalum gauze, drains should be placed. Cigaret drains are used, and are placed through stab wounds in the most dependent portion of each dissected skin flap. These drains are removed in from three to five days. If they are not used, serum invariably collects which necessitates aspiration. The drains drain off the serum instead of allowing it to pool. The reason for the collection of serum is twofold. First, in the dissection of large skin flaps absolute hemostasis is impossible. Second, the implantation of the tantalum gauze leaves certain small dead spaces between the gauze and the fascia and between the gauze and the subcutaneous tissue, and dead spaces invariably invite the collection of serum.

Bold is the man in surgery who says that *this* is the way to do it and any other way is wrong. The principles and methods laid down here have been formulated as the result of my own personal experience. There may be other and better ways. However, we learn only by an exchange of experiences. A great surgical teacher, the late Dr. J. M. T. Finney, was frequently heard to say: "There is no such word as *always* in medicine and there is no such word as *never* in medicine." Nothing *always* happens the same way, and almost anything *can* happen.

SUMMARY

Tantalum gauze and wire (both monofilament and braided) cause no trouble in the presence of infection, such as persistent sinus tracts or persistent buried infected granulomas, unless they are accompanied by other foreign bodies, as, for example, silk or cotton, which are known to cause these conditions. Therefore, in the presence of infection, no attempt should be made to remove the tantalum gauze, but other factors which tend to produce trouble in the presence of infection should be dealt with in a logical manner.

If for any reason implanted tantalum gauze becomes exposed, unless there is an associated dead space, granulations will grow through the gauze and the wound will heal spontaneously.

Whenever possible abundant subcutaneous tissue should be left under the skin flaps used to cover tantalum.

In potentially infected ventral hernia wounds, the peritoneum should be closed with braided tantalum wire (which does not cut through). Monofilament or braided tantalum wire may be used to suture the tantalum gauze in place, and catgut should be used for ligatures. Silk and cotton should not be used in such wounds (except possibly in the subcutaneous tissue) as they cause trouble in the presence of infection.

When extensive dissection of skin flaps is necessary, drains should be used in order to prevent the collection of serum.

REFERENCES

1. Babcock, W. W.: Metallic sutures and ligatures, Surg. Clin. N. America *27:* 1435 (Dec.) 1947.
2. Bussabarger, R. A., Dumouchel, M. L., and Ivy, W. H.: Use of tantalum mesh to repair large surgical defect in anterior abdominal wall, J. A. M. A. *142:* 984 (April 1) 1950.
3. Crile, G., Jr., and King, D. E.: Successful use of tantalum mesh to repair an abdominal wall defect in presence of massive fecal contamination; report of case, Surgery *29:* 914 (June) 1951.
4. Gardner, W. J.: Use of tantalum for repair of cranial defects in infected cases, Cleveland Clin. Quart. *13:* 72 (April) 1946.
5. Koontz, A. R., and Kimberly, R. C.: Tissue reactions to tantalum mesh and wire, Ann. Surg. *131:* 666 (May) 1950.
6. Koontz, A. R.: Repair of ventral hernias with tantalum mesh; preliminary report, South. M. J. *41:* 214 (March) 1948.
7. Koontz, A. R.: Preliminary report on use of tantalum mesh in repair of ventral hernias, Ann. Surg. *127:* 1079 (May) 1948.
8. Koontz, A. R.: Tantalum mesh in hernia repair; experimental and clinical results, Tr. South S. A. *60:* 394, 1948.
9. Koontz, A. R., and Kimberly, R. C.: Tissue reactions to tantalum gauze and stainless steel gauze; an experimental comparison. To be published in Am. Surg.
10. Lam, C. R., Szilagyi, D. E., and Puppendahl, M.: Tantalum gauze in repair of large postoperative ventral hernias, Arch. Surg. *57:* 234 (Aug.) 1948.
11. Meleney, F. L.: Infection in clean operative wounds, a nine year study, Surg., Gynec. & Obst. *60:* 264 (Feb. 15) 1935.
12. Price, P. B.: Stress, strain and sutures, Ann. Surg. *128:* 408 (Sept.) 1948.
13. Ruggiero, A.: L'impiego dei fili e della rete di tantalio nelle plastiche abdominali, Gior. ital. chir. *8:* 78, 1952.
14. Schlaepfer, K.: Tantalum wire in surgery, J. Internat. Coll. Surgeons *11:* 288 (May–June) 1948.
15. Weiford, E. C., and Gardner, W. J.: Tantalum cranioplasty; review of 106 cases in civilian practice, J. Neurosurg. *6:* 13 (Jan.) 1949.
16. Wright, F. W.: Personal communication, May 19, 1949.

PERSISTENT PAIN FOLLOWING CHOLECYSTECTOMY

HU C. MYERS, M.D.

Philippi, W. Va.

Persistent or recurrent pain in the epigastric region or right hypochondrium following cholecystectomy is a common occurrence. It may result from (1) errors in diagnosis and consequent improper or inadequate treatment, (2) failure of the surgeon to remove all of the pathology, or (3) a complication of the operation. The last is uncommon.

Over the past 30 years, remarkable advances have been made in the surgical management of gallbladder disease, mainly through studies of the physiology and pathology of the liver, gallbladder, and bile ducts. Efficient diagnostic procedures have been perfected. A perusal of the literature, however, leaves one with the distinct impression that a feeling of uncertainty exists regarding three important points: (1) the merits of diagnostic duodenal drainage, (2) the role of dyskinesia in the production of symptoms, and (3) the indications for surgical intervention.

Since 1938 our group has been concerned with these problems. We have taken especial interest in the use of various diagnostic tests; we have attempted to correlate the pathologic findings with the patient's symptoms; and we have followed the subsequent course of these patients. A preliminary report[4] of these studies was made to this Congress in 1941. At that time, the results which had been obtained were promising but left much to be desired. The study now covers a period of 15 years, during which time, our group has completed a series of 3,444 cholecystograms and 3,554 diagnostic duodenal drainages (Table I). Using these diagnostic aids, we have improved the accuracy of diagnosis to such an extent that for the past 12 years the preoperative and postoperative diagnoses have essentially agreed in over 95 per cent (95.92 per cent) of all cases in which cholecystectomy was done. During this 15 year period, we have limited cholecystectomy, except in rare instances, to acute cholecystitis and to gallbladders containing calculi. The decision to abandon cholecystectomy for the noncalculous *chronic cholecystitis* was based on the high rate of persistence of symptoms which we had found in our cases prior to 1938.

In order to determine how many patients had one or more major attacks of pain, in the years following cholecystectomy, a review of all our cases from the inception of our group in 1933 was made. Table II gives the number of cholecystectomies by year, and the accompanying graph (Chart 1) gives the per cent with calculi. There were 374 operative procedures with four deaths, a mortality rate of 1.07 per cent. Of the gallbladders removed, 324 contained stones and 50 were noncalculous.

Of those with calculous gallbladders, 44 were lost to follow-up leaving 280

From the Myers Clinic, Philippi, West Virginia.
Presented during the Louisville Assembly of The Southeastern Surgical Congress, March 9–12, 1953, Louisville, Kentucky.

for study. Of these, 55 had one or more significant attacks of pain following cholecystectomy, or an incidence of approximately 20 per cent.

Of the 50 patients with noncalculous gallbladders, 13 were lost to follow-up leaving 37 for study. Of these 37 patients, 23 had one or more major attacks of pain following cholecystectomy making an incidence of approximately 62 per cent. In this series, persistent pain, following cholecystectomy, was three times as frequent in the patients who had noncalculous disease of the gallbladder, as in those with calculous disease (Chart 2).

The total number of patients having persistence of pain following cholecystectomy was 78. The lack of definite diagnoses on the charts of 12 of the earlier of these 78 left 66 for study. In all of the cases of the past 15 years, a definite attempt was made to determine the cause of the pain. The studies included a

TABLE I

Gallbladder review

1933–52

Cholecystographic studies	3,444
Diagnostic duodenal drainages	3,554
Cholecystectomies	374
Operative deaths	4
Mortality rate	1.07%

TABLE II

Cholecystectomies, by the year

	Year																			Total
	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	
Calculous gallbladders	1	6	0	8	2	5	3	12	11	17	9	6	23	17	29	27	33	29	41	45	324
Noncalculous gallbladders	4	4	3	5	3	6	4	5	0	1	2	1	1	0	4	0	1	0	3	3	50
Total	5	10	3	13	5	11	7	17	11	18	11	7	24	17	33	27	34	29	44	48	374

careful history, physical examination, gastric analysis, duodenal drainage, gastrointestinal roentgenographic series, and icterus index. Liver function studies and other tests were done in special cases. Objective evidence of specific disease was sought and found in almost every instance. Diagnosis by exclusion was seldom necessary and exploratory laparotomy was rarely used.

There were 19 different diagnoses in the 66 cases, presenting pain syndromes. For simplification, they were divided into three groups: (1) those with spasm of the sphincter of Oddi, (2) those with organic disease of the extrahepatic biliary duct system, and (3) diseases not related to, or primarily of, the bile ducts (Table III).

The first group, those cases with duodenal spasm and spasm of the sphincter of Oddi, has been classified as dyskinesia of the gallbladder or bile ducts. This group has been further subdivided by Carter and his associates[1] into two different

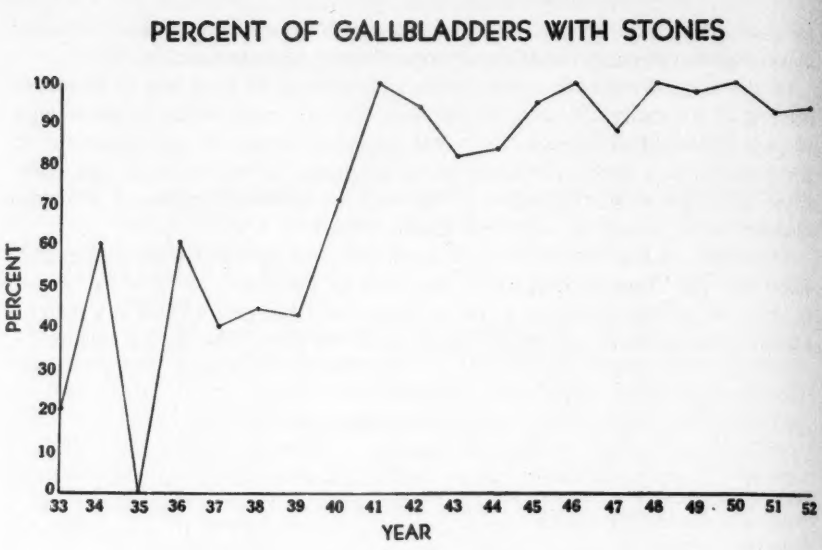


CHART 1

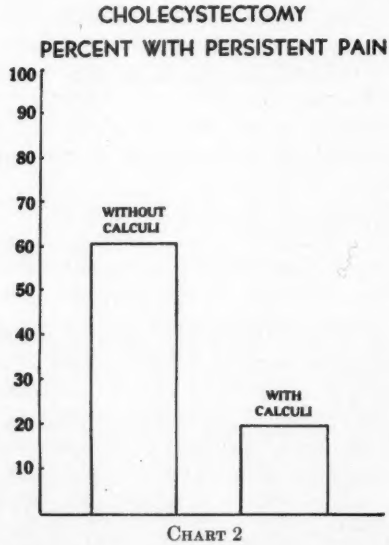


CHART 2

clinical entities: reflex spasm, usually associated with psychoneurosis; and spasm, resulting from hyperacidity. Thirty of the cases were considered to be of reflex origin and 13 were associated with hyperacidity. Many of the latter also had duodenal ulcers. Thus a total of 43 of the 66 cases, or 65 per cent of the painful

syndromes, were functional in origin. Most of these, having been followed for many years, have shown periods of exacerbation and relief just as do patients with other manifestations of psychoneurosis or with peptic ulcer. They needed dietary and medical management or psychotherapy before their gallbladders were removed. They still need the same treatment. Whether one is to include them under the term *postcholecystectomy syndrome*, I think, is splitting hairs. They had pain before cholecystectomy; they have pain afterward. If the term is not suitable for pain, following cholecystectomy, perhaps, the name should be changed to an all inclusive term, such as, *persistent pain, following cholecystectomy*. Since this group, due to errors in diagnoses and consequent inadequate or improper treatment, forms the largest part of this series, I think it is safe to assume that it would be the larger part of any series.

The second group comprised those cases with organic pathology which had been inadequately treated by operation. Choledocholithiasis was found in 5 and was treated by exploration of the common duct with removal of the stones. Calculi were found in the stump of the cystic duct in 2 cases. These were treated by resection of the remnant of the duct containing the stones. Carcinoma of the head of the pancreas was found in 2 cases and pancreatitis in 1. Thus organic

TABLE III

Causes of pain (groups)

Dyskinesia (spasm of sphincter of Oddi)	43 (65%)
Organic disease of bile ducts	10 (15%)
Diseases not primarily related to bile ducts	13 (20%)

causes were found in 10, 9 of which were treated by operation and 1 was inoperable.

Of the third group, those not primarily related to the bile ducts, 4 had segmental neuralgia and 2 had coronary insufficiency. There was 1 each of the following: malignancy of the spine, epigastric hernia, esophageal hiatus hernia, cholangiohepatitis, giardiasis, and delayed wound abscess. One was diagnosed as abdominal adhesions (Table IV).

It is recognized that there are many causes of epigastric and right hypochondriac pain that were not found in our series of cases. We have found several other causes, but they were in patients who were not subjected to cholecystectomy or in patients who had had a cholecystectomy elsewhere. Obviously, they could not be included in this report. Stricture of the distal end of the common duct has recently received attention by Cole[2] and others; amputation neuromas of the cystic duct have been described by Womack[5]; and allergy may produce attacks of colic which must be differentiated from true biliary tract disease.

In the past 15 years, most of our cases of functional gallbladder disease, or dyskinesia, which have been associated with stones, have been diagnosed preoperatively. In these cases, the patients have been told that cholecystectomy will not completely relieve their symptoms. It has been a source of satisfaction, to the members of our group, to be able to make fairly accurate predictions in

this regard, and to lay the groundwork preoperatively for later cooperation of the patient in continuing medical, dietary, and psychotherapy as needed.

An attempt was made to secure from the literature information regarding the pathology of gallbladders removed elsewhere, but no recent series was found. A comment was found in a 1952 textbook of surgery[3] which says that, "At least 50 per cent of the gallbladders, removed surgically throughout the country, contain stones." It would seem proper to assume that this statement infers that nearly 50 per cent of the gallbladders removed do not contain stones. If this is the case, persistent pain following cholecystectomy must be a common occurrence. A further appraisal of, and a more widespread use of specific medical

TABLE IV

Causes of pain (specific entities)

Dyskinesia (spasm)	
Reflex type	30
Hyperacidity	13
Organic	
Choledocholithiasis	5
Stones in cystic duct	2
Carcinoma head of pancreas	2
Pancreatitis	1
Other	
Segmental neuralgia	4
Coronary insufficiency	2
Malignancy of spine	1
Epigastric hernia	1
Esophageal hiatus hernia	1
Cholangiohepatitis	1
Giardiasis	1
Delayed wound abscess	1
Abdominal adhesions	1
Total	66

measures for noncalculous disease and for dyskinesia associated with stones would seem to be the logical measures for improving results.

CONCLUSIONS

Persistent pain following cholecystectomy is largely caused by mistakes in diagnosis, failure to remove the pathology, or complications of the operation. Results can be improved by (1) abandoning cholecystectomy for noncalculous *chronic cholecystitis* except in rare instances, and substituting medical therapy directed at the cause; (2) recognizing and applying all of the diagnostic procedures currently available; (3) using care in exploration of the common duct where it is indicated, making sure that all stones have been removed, and that the opening into the duodenum is adequate; (4) removal of the entire cystic duct but, at the same time, using especial care to do no harm to the common duct.

The results of gallbladder surgery should be good, and pain following cholecystectomy should be avoided in most cases. But this ideal can only be attained if competency in diagnosis is achieved; if a clear understanding of indications for surgical intervention is acquired; and if excellence in technic is developed by the surgeons who make the diagnoses and perform the operations.

REFERENCES

1. Carter, R. F., Greene, C. H., and Twiss, J. R.: Diagnosis and Management of Diseases of the Biliary Tract, pp. 28–33, Philadelphia, Lea and Febiger, 1939.
2. Cole, W. H.: Recent trends in gallbladder surgery, J. A. M. A. *150:* 631 (Oct. 18) 1952.
3. Cole, W. H., and Elman, R.: Textbook of General Surgery, ed. 6, p. 659, New York, Appleton-Century-Crofts, 1952.
4. Myers, H. C.: Duodenal drainage in diagnosis of gallbladder disease, South. Surgeon *10:* 653 (Sept.) 1941.
5. Womack, N. A., and Crider, R. L.: Persistence of symptoms following cholecystectomy, Ann. Surg. *126:* 31 (July) 1947.

GASEOUS DISTENTION OF THE GASTROINTESTINAL TRACT—ITS SIGNIFICANCE, PREVENTION AND TREATMENT

WILLIAM H. PRIOLEAU, M.D.* AND J. MANLY STALLWORTH, M.D.*

Charleston, South Carolina

On account of its untoward effects, gaseous distention of the gastrointestinal tract should be prevented if possible, and when present every effort should be directed toward its relief. The potential seriousness of this condition becomes apparent upon reviewing its all-too-common sequellae. When present to even a moderate degree it interferes with nutrition requiring parenteral alimentation to prevent metabolic disorders, and if allowed to increase, it eventually leads to edema and even gangrene of the bowel wall as a result of interference with the blood supply. The peritoneal cavity is less able to withstand contamination and combat infection if there is diminished circulation of the distended bowel. The upward pressure upon the diaphragm by a distended stomach or bowel interferes with cardiac function, and also with expansion of the lungs, and predisposes to atelectasis and pneumonia. The cardiorespiratory embarrassment results in hypoxemia, a condition which may be attended by serious sequellae. The increased intra-abdominal pressure interferes with the venous return from the legs, and predisposes to thrombosis which may result in embolism. Following gastric or intestinal resection, the increased intraluminal pressure may interfere with healing, which causes leakage at a suture line and contamination of the peritoneal cavity. Especially when accompanied by vomiting, distention may result in dehiscence of an abdominal wound.

It is now conclusively established that in distention of the gastro-intestinal tract the source of the gas is predominantly from the atmospheric air.[8] The amount arising from putrefaction and fermentation of intestinal contents is of minor importance. The mechanism of *air entrance* into the gastro-intestinal tract has been the subject of some controversy. For a long time it has been attributed solely to air swallowing, but this explanation does not cover such cases as distention while the patient is very toxic, comatose, or under anesthesia, and obviously cannot swallow. Recently Maddock, Bell, and Tremaine[6] demonstrated experimentally and clinically that under certain conditions the patient attempts to inspire against a closed glottis with the superior constrictor muscle of the esophagus relaxed, with the result that air is freely drawn into the stomach. A patient need not be unconscious for air to enter the stomach in this manner, a familiar example being the aerophagic. These authors further demonstrated that in normal subjects gas, even in large quantities, passes rapidly through the gastro-intestinal tract to be passed per rectum

* From the Department of Surgery of the Medical College of South Carolina and Roper Hospital, Charleston, South Carolina.

Presented during the Louisville Assembly of The Southeastern Surgical Congress, March 9–12, 1953, Louisville, Kentucky.

Distention occurs when there is interference with the onward passage of the intestinal contents. The distended bowel contains mostly gas, which is predominantly nitrogen due to its poor absorption by the blood which is 80 per cent saturated with it, while the fluid absorption continues until the intestinal function is more seriously deranged.

The etiologic factor in distention may be developmental, inflammatory, neoplastic, nervous, metabolic, and even psychic. Obstruction of a mechanical nature may be partial or complete. It may be intraluminal, intramural, or extramural, with or without compromise of the blood supply. Important in this group are postoperative adhesions.

Among the common causes of distention are trauma at operation due to rough handling of the tissues, and the use of gauze packs in excessive amount and which may be unduly hot.[5] Inflammation of the intestinal walls in peritonitis causes ileus of varying degrees. Peristalsis may be interfered with by reflex nervous disturbance in such conditions as a vertebral column injury, a retroperitoneal hemorrhage or some painful intra-abdominal condition such as gallstone colic or pancreatitis. Distention may result from edema of the intestines due to such metabolic disorders as hypoproteinemia, vitamin deficiency, and potassium deficiency. Distention also occurs in virulent infections such as pneumonia.

While efforts should be directed toward the prevention and relief of gaseous distention, due consideration must be given the underlying disease process so that the over-all treatment can be governed accordingly. Such conditions as intestinal obstruction, strangulation, perforation, and peritonitis must be recognized early and appropriate measures taken. In conditions where distention is likely to develop, it is important to institute early preventive measures. The same measures are applicable, but they are less effective when distention is present. In the less serious cases, simple measures such as limiting the intake by mouth and early ambulation are generally adequate. The most effective preventive measure is the inlying stomach tube to which constant suction is applied. When properly used it prevents the passage of liquids and gas beyond the pylorus. It is also of value in the presence of distention in that it prevents the placing of an additional load upon the intestines and removes material which has regurgitated from the intestines into the stomach. In the treatment of distention, intubation of the intestine with the Miller-Abbott tube, or some modification of it, is a more effective measure than the stomach tube as it empties the intestine from above downward—thus permitting it to regain its tone. At times, there is difficulty in getting the end of the tube to pass through the pylorus. To overcome this difficulty there have been developed a number of methods among which are the use of fluoroscopic control, weighting the end of the tube with mercury or lead, using a stylet, and more recently using magnetic control,[2] a method which gives great promise. A tube may be introduced into the intestine preoperatively, or during operation by manipulating its end through the pylorus, as a means of preventing undue tension upon an anastomotic suture line. In such cases it may be well to use in addition an inlying stomach tube.

The effective use of inlying stomach and intestinal tubes requires attention to

detail and constant vigilance. The more common causes of failure are partial occlusion by using small connecting tubes; kinking or knotting of the distal end of the tube; and occlusion of the openings in the tube with mucosa due to the application of too great suction. An air-vent[3] has been designed by Devine to overcome the last named fault. Should passage of the Miller-Abbott tube through the pylorus be time consuming and attended by difficulty, a single lumen tube of the Cantor type should be substituted as this will at least drain the stomach satisfactorily. Barium and lipiodol occlude the small lumen of the Miller-Abbott tube, and therefore cannot be used for roentgenologic examination in conjunction with the tube.

Numerous bizarre accidents have been reported caused by the use of suction tubes.[7] Long use of these tubes may result in ulcer formation or even perforation anywhere along their course. Roentgenologic control constitutes a valuable safeguard. Due to the tendency of the intestine to telescope upon the tube, the end may be advanced further than is realized. Should a rubber bag containing mercury pass through the ileo-cecal valve, withdrawal of the tube becomes virtually impossible, and passage by rectum or removal by operation becomes necessary.

Where it is important that the distention be relieved and the intestine cannot be intubated effectively, an enterostomy should be performed. This procedure was frequently used before the development of intestinal intubation. To be effective, it must be performed before the intestines become edematous and an irreversible reaction has taken place.

Upon resumption of peristalsis, the stomach, intestinal and enterostomy tubes may cease to become completely effective and some of the intestinal contents may bypass them resulting in a bowel movement. While using these tubes, it is important to guard against dehydration, chloride and potassium depletion and other metabolic disturbances.

Tubes used for decompression of the stomach and intestines are removed only after the distention has been relieved; peristalsis has been resumed; and the continuity of the bowel has been demonstrated. It is to be emphasized that once distended, the intestine regains its tone slowly. A trial occlusion of the tube is often of value in preventing its too early removal.

Distention due to obstruction of the large intestine, especially in the presence of a competent ileo-cecal valve, may require a cecostomy or colostomy. In such cases, the additional use of suction intubation of the stomach or small intestine may be of decided advantage. In the case of an anastomosis of the large intestine, an appendico-cecostomy performed at the same time safeguards the suture line against intra-luminal tension. It is easily closed by removing the tube.

Thus far all attention has been directed toward preventive measures and to relieving the distended bowel of some of its load by removing its contents from above. Except in cases of fecal impaction and obstruction due to stricture or neoplasm within easy access of the anal orifice, attempts to relieve distention by measures directed through the rectum are of little value and may be harmful. The rectal tube often traumatises the anal tissues and performs no necessary

function. When gas reaches the rectum it soon passes of its own accord either audibly or insensibly. Unless there is solid matter in the rectum or sigmoid, the enema is of no value other than to serve as a mild stimulus to peristalsis. In case of atony of the bowel the enema fails to be expelled and only increases the distention by adding to the contents of the abdominal cavity, which often exhausts the patient. Too rapid absorption of the water may cause overhydration. The so-called *high enema* is a snare and a delusion. It is both difficult and dangerous on account of possible perforation, particularly in the presence of distention, to attempt the insertion of a rectal tube more than a few inches above the anal orifice. As can be demonstrated roentgenologically, the height of the enema is determined by the level to which the column of fluid reaches. This in turn is dependent upon the volume of the fluid, the position of the patient and the condition of the bowel.

Parasympathomimetic drugs have little or no place in the treatment of acute distention. If ineffective in emptying the already fatigued bowel, there is danger of a reaction from such stimulation resulting in increased distention. These drugs are especially contra-indicated when there is a recent intestinal suture line or the likelihood of a mechanical obstruction. Their value as a prophylactic measure is not well established. They are useful primarily in cases of mild atony of the bowel.

The administration of oxygen by nasal tube or tent has a definite place in the treatment of abdominal distention.[4] It relieves the load upon the embarrassed cardio-respiratory mechanism, thus tending to prevent hypoxemia. It is also thought to make possible increased absorption of nitrogen from the intestine by lowering the nitrogen concentration in the blood.

In every case of abdominal distention there must be considered the possible presence of intestinal obstruction with a compromise of the blood supply. Roentgenologic examination is of value in determining the site of obstruction, whether it is incomplete or complete, and the degree of distention. Neither roentgenogram nor any other laboratory examination gives definite information concerning the presence or absence of a compromised blood supply. This was demonstrated recently in an impressive series of cases reported by Becker.[1] Should there be any reasonable doubt, operation should be performed, and suction intubation should be used only as a preoperative measure. One must guard against a false sense of security which is based upon the remarkable relief commonly afforded by effective bowel decompression.

SUMMARY

1. The untoward effects of distention of the gastrointestinal tract are potentially serious.

2. Swallowed and ingested atmospheric air is the predominant factor in bowel distention.

3. Suction intubation of the stomach and intestine, and enterostomy are effective measures for prevention and treatment.

4. Enemas and parasympathomimetic drugs are of little value and at times are harmful.

5. Compromise of the blood supply must not be overlooked.

REFERENCES

1. Becker, W. F.: Acute adhesive ileus, Surg., Gynec. & Obst. *95:* 472 (Oct.) 1952.
2. Devine, J. W., Jr.: Personal communication. To be published in Surgery.
3. Devine, J. W., Jr.: A new tube for use in treatment of intestinal obstruction, J. A. M. A. *148:* 115 (Jan.) 1952.
4. Fine, J., Banks, B. M., Sears, J. B., and Hermanson, L.: Treatment of gaseous distention of intestine by inhalation of 95 per cent oxygen; description of apparatus for clinical administration of high oxygen mixtures, Ann. Surg. *103:* 375 (March) 1936.
5. Kredel, F. E., and Smithy, H. G.: Adhesions from hot laparotomy pads, Surgery *10:* 45 (July) 1941.
6. Maddock, W. G., Bell, J. L., and Tremaine, M. J.: Gastro-intestinal gas, Ann. Surg. *130:* 512 (Sept.) 1949.
7. Pool, R. M.: Unusual experience with Miller-Abbott tube, Ann. Surg. *130:* 267 (Aug.) 1949.
8. Singleton, A. O., Rogers, F., and Houston, F. G.: Problem of intestinal gases complicating abdominal surgery, Ann. Surg. *115:* 921 (June) 1942.

HYPOPARATHYROIDISM FOLLOWING THYROID OPERATIONS

JACK W. PATTERSON, M.D.*

Wichita, Kansas

AND

GEORGE A. HIGGINS, M.D.†

Kansas City, Missouri

The first case of tetany following a thyroid operation was described in 1879 by Wolfler[22] working in Billroth's clinic in Vienna. Typical findings of tetany which occurred on the sixth post-operative day followed by two milder attacks a few days later were described. The symptoms were ascribed to disturbances in the circulation of the brain due to removal of the thyroid. Some years later in 1883 Weiss[21], also working in Billroth's clinic, reported 8 cases of postoperative tetany in which convulsions appeared three to four days after operation. The symptoms were attributed to reflex irritation from injury to the nerves in the thyroid gland and the recurrent laryngeal nerves, a belief which apparently persisted for some years. Kocher[18], one of the great pioneers of thyroid surgery, observed remarkably few cases of tetany in the 3000 goiter operations done in his clinic. This was undoubtedly due to his practice of always preserving the posterior thyroid capsule. In the few cases observed, tetany was regarded as an acute form of cachexia strumipriva.

Mikulicz[14] had frequently observed cachexia strumipriva, or tetany, or both, following total thyroidectomy. He attributed the tetany to reflex irritation due to injury or severance of nerves of the thyroid. His custom of leaving a small portion of the posterior part of the gland prevented the occurrence of either cachexia strumipriva or tetany. During the 1890's Gley[9] and Vassale and Generali[20] showed by extirpation experiments that tetany is due to damage or removal of the parathyroid glands, thus demonstrating the soundness of the Mikulicz procedure. Subsequently work on the physiology of the parathyroids was done chiefly by Americans. The discovery that serum calcium levels were low in hypoparathyroidism was made by McCallum and Voegtlin[2] in 1909. In 1924 and 1925 Hansen and Collip[2], working independently, extracted the active principle from the parathyroid gland. Parathyroid physiology, with calcium and phosphorus metabolism, has been studied by numerous investigators chiefly concerned with hyperparathyroidism. Outstanding among these investigations have been those of Albright.[1] There still remains, however, several unanswered questions concerning the exact mechanism involved in calcium and phosphorus metabolism.

From the Veterans Administration Center, Wichita, Kansas.
* Assistant Chief, Surgical Service, Veterans Administration Center, Wichita, Kansas.
† Chief, Surgical Service, Veterans Administration Hospital, Kansas City, Missouri.

ANATOMY

The parathyroid glands, usually four in number, are small, bean shaped bodies, yellow-brown in color, commonly located in the tracheo-esophageal sulcus behind the thyroid. The superior parathyroids develop embryologically from the fourth branchial clefts and their adult positions are posterior to the undersurface of the superior thyroid poles. The inferior glands develop from the third branchial cleft in association with the thymus and are most commonly found on the posterior surface of the thyroid at the location where the inferior thyroid artery enters the gland. However, the location of the glands may vary considerably, ranging from the upper pole of the thyroid down into the mediastinum in the vicinity of the aortic arch and pericardium, a fact of great importance in searching for parathyroid adenomas. The parathyroids receive their blood supply from the terminal branches of the thyroid arteries. Hence, the circulation to the parathyroids may be jeopardized in radical removal of thyroid glands with resultant transient tetany.

PHYSIOLOGY

Details of parathyroid physiology and calcium and phosphorus metabolism remain controversial. One group believes that the parathyroid hormone acts directly on bone metabolism, the body electrolyte changes being secondary to bone changes; whereas, the second group are of the opinion that the hormone controls the absorption and excretion of calcium and phosphorus, the bone changes being secondary. Albright[1] states that the parathyroid hormone affects the phosphate dissolved in the body fluids to make it more readily excreted by the kidneys, thereby lowering the serum phosphorus level. This change in the body fluids leaves them less saturated and disturbs the equilibrium which determines the calcium and phosphorus levels in the serum. The absorption from bone is increased to compensate for these changes; consequently the serum calcium level is elevated, and the serum phosphorus level is decreased. Regulatory mechanisms are ever present to maintain the electrolyte values in body fluids within a fairly constant range. Calcium in excess in the serum is lost through the kidneys. If it were not for the fact that there is an increased absorption from the gastrointestinal tract, a greater urinary loss of calcium would result in a deficit. At the risk of over-simplification, it may be said that the hormonal effect of the parathyroid gland is upon phosphorus excretion by the kidneys and upon calcium absorption from the gastrointestinal tract.

Although, as indicated above, the mechanisms are not entirely clear, parathyroid deficiency produces three sets of changes in the body physiology, all having to do with the metabolism of calcium and phosphorus. First, there is a decreased absorption of calcium and an increased absorption of phosphorus from the gastrointestinal tract. Second, there is a decrease in total urinary calcium excretion and an increase in phosphorus excretion. Third, these changes are reflected in the blood serum by a high serum phosphorus level and a low serum calcium. Clinical and laboratory findings in the hypoparathyroid patient result from these changes, and the treatment of such patients involves the correction of these alterations in body physiology.

CLINICAL CONSIDERATIONS

The clinical manifestations of hypoparathyroidism are chiefly those of increased neuromuscular irritability caused by a decrease in the ionized calcium in the blood; the severity of symptoms depending upon the degree of parathyroid deficiency. On a purely arbitrary basis postoperative tetany is usually classified as transient or permanent depending upon whether the symptoms persist beyond one year. Parathyroid deficiency often occurs following operations for recurrent goiter. Presumably, although controlled studies are obviously not available, the glands may be traumatized or inadvertently removed during operation, or the blood supply may be sufficiently embarrassed to cause atrophy of the glands. The practice of carefully examining each thyroid lobe removed, for the possible presence of parathyroid tissue with the idea of reimplanting such tissue into the neck muscles is almost universally followed. Evidence of such gland tissue remaining viable is based only upon gradual clinical improvement of the patient. Inflammatory changes in both the thyroid and parathyroid glands are said to account for some cases of tetany.

Several case series of postoperative hypoparathyroidism have been presented. Claiborne[19] in 1936 reported 26 cases in 12,000 thyroid operations, and Boothby, Haines and Pemberton[5] studied 88 cases seen at the Mayo Clinic between 1924 and 1929. In 1951 Bell and Bartels[3] recorded 58 cases of tetany in a series of 2000 patients operated upon for hyperthyroidism, an incidence of 2.9 per cent. Of these 58 cases, 32 were classified as transient, the symptoms subsiding in one year or less, while 16 cases were regarded as permanent. The remaining 10 cases were not classified.

Symptoms of tetany usually become evident on the first to the sixth postoperative day. The rapidity of onset is no indication of severity or permanency. Initial manifestations are usually numbness or tingling of the fingers and toes followed by cramping sensations. Contraction of muscle groups, such as carpopedal spasm, laryngeal spasm and convulsions, may occur.[23] Initially, the patient frequently becomes anxious or depressed with a somewhat impaired intellect, stupor, or even hallucinations. Acute sensation of pain produced by pressure along sensory nerves, particularly along the ulnar or peroneal nerves, may be suggestive.[4] Loud noises and low temperatures are not well tolerated. Sensations of taste, smell, sight, or hearing may be altered to some degree. Emotional disturbances, such as crying without cause, complaints of paresthesia, palpitation, vascular disturbances and transient edema may be the only symptoms recognized.[11]

In addition to objective signs of the acute manifestations of hypocalcemia, subjective signs will usually become positive by the second postoperative day, particularly if the serum calcium drops 2 mg. per 100 cc. Trousseau's sign may be positive and ocular muscle spasm may be noted which makes accommodation quite difficult. If the recurrent laryngeal nerve has been traumatized to a slight degree, there may be spasm of the vocal cord similar to the spasm noted in Trousseau's sign. This, however, does not usually become positive until approximately the third or fourth postoperative day and particularly not until the

serum calcium reaches the level of 6 to 7 mg. per 100 cc. This adductor spasm of the vocal cords may lead to serious respiratory distress and has accounted for a few fatalities attributed to parathyroid deficiency. In fact the other manifestations of tetany, while being quite alarming, rarely endanger the patient's life. The onset of tetany usually gives more than adequate warning to allow proper corrective measures to be taken before serious consequences develop.

If the manifestations of a lowered serum calcium go unrecognized some of the later objective signs that may become evident are coarseness, thickening and scaling of the skin, ridging and brittleness of the nails, coarseness of the hair, grooving and pitting of the teeth and later on calcified areas in the basal ganglia. It is only when the pathologic changes are extreme that calcification in the basal cerebral areas can be demonstrated by the roentgenogram. Some authors[6, 7, 17] believe that patients showing symmetrical calcifications in the basilar ganglia with the history or the findings of tetany should be investigated for hypoparathyroidism. Formation of cataracts is an additional late change, which, on the average as stated by some authors[3, 5] occurs approximately two years after the onset of hypoparathyroidism.

Hypoparathyroidism may occur following removal of an adenoma of the parathyroid when those glands not involved are at rest and in a state of hypofunction. In such cases symptoms may be severe and require vigorous therapy during the early postoperative period.

DIAGNOSIS

In most instances parathyroid deficiency following operation becomes quickly apparent, leaving little doubt of the diagnosis. Of course, the tetany of hypoparathyroidism is essentially the same clinically as the tetany of hyperventilation and the tetany occurring in alkalosis due to disturbances in electrolyte balance.[10] Likewise convulsive seizures of various causes occurring in the postoperative patient might be suggestive of the convulsions occurring in severe hypoparathyroidism. Occasionally the initial manifestations of hypoparathyroidism may be depression, anxiety, stupor or hallucinations suggestive of a neuropsychiatric disturbance. However, complaints of numbness or tingling of the fingers or toes followed by muscle cramping occurring on the first to sixth day following thyroid operation leaves little doubt of the diagnosis. Of the various signs demonstrating increased neuromuscle irritability, Trousseau's sign is perhaps the most reliable.

As confirmatory evidence laboratory findings are of considerable help in establishing the diagnosis and serve as a reliable guide to treatment. A low serum calcium, high serum phosphorus and minimal or absent calcium in the urine are strongly indicative of deficient parathyroid function. A serum calcium level of 7 to 8 mg. per 100 cc. is stated as the threshold below which urinary calcium secretion does not occur.

A simple and reliable test of urinary calcium is that devised by Sulkowich. This test is a rough quantitative one in which the amount of calcium excreted in the urine is determined by the intensity of the precipitate obtained when equal parts of urine and Sulkowich reagent are combined. No precipitate indi-

cates a serum calcium level of 5 to 7.5 mg. per 100 cc. A heavy or milky precipitate indicates levels in excess of normal, probably above 11 mg. per 100 cc.

In conditions such as hyperventilation tetany or the tetany associated with alkalosis the serum levels of calcium and phosphorus are normal as is the level of urinary calcium excretion. In renal insufficiency, rickets, osteomalacia, and sprue there may be a hypocalcemia and/or hyperphosphatemia. However, the history and clinical picture will rule out confusion with hypoparathyroidism. In the pseudohypoparathyroidism of childhood there is no failure of production of the parathyroid hormone but rather a failure to react or respond to the hormone.

TREATMENT

There are essentially three phases through which the successful treatment of the patient may go. During the first phase the chief concern is the treatment of acute tetany. In the second phase the treatment must be adjusted for long term control of the symptoms of tetany. The last phase is the determination of whether or not the hypoparathyroid state is permanent or transient. During the initial phase the hypocalcemic state, which is responsible for the tetany, must be corrected. The hyperactive neuromuscular response, which is basically responsible for both objective and subjective signs of tetany, readily responds to serum calcium replacement.[16] Ten to 20 cubic centimeters of a 10 per cent solution of calcium chloride or calcium gluconate administered intravenously usually will allay tetany. It may be more advisable to give 1,000 to 2,000 cubic centimeters of 1 per cent calcium gluconate rather than a more concentrated form. In patients taking digitalis, such treatment must be carefully supervised to prevent cardiac standstill. One to 2 teaspoonsful of calcium lactate dissolved in boiling water three times daily may serve as maintenance dose.

If the patient is given prompt treatment with calcium, hypoparathyroid tetany should be adequately controlled within the first few days of its onset. Attention then must be turned toward adequate prolonged control. Serum calcium and urinary calcium levels must be determined frequently to insure levels of slightly below normal to normal values. As the patient approaches a controlled state, the serum phosphorus levels will again drop to relatively normal values. As calcium is made available to the body, both from the gastro-intestinal tract and by parenteral means, dietary measures consisting of a regular diet, from which milk has been withdrawn, supplemented by powdered calcium lactate given orally, are of value. Milk is not only rich in calcium but also in phosphorus, and is therefore unsuitable as a source of calcium. One to 2 teaspoonfuls of a 3 per cent to 4 per cent aluminum hydroxide preparation daily is of value since it restricts the absorption of phosphorus from the gastro-intestinal tract.

Vitamin D in doses of 150,000 to 400,000 units daily is of definite therapeutic value although it is less efficacious than dihydrotachysterol. Dihydrotachysterol ($C_{28}H_{45}OH$) is a dihydro form of tachysterol which is an irradiated product of ergosterol.[13] Tachysterol is approximately one-third as toxic as vitamin D and

also is more efficient in raising serum calcium levels.[12] Though vitamin D is a cheaper form of therapy, dihydrotachysterol (A.T. 10) offers definite advantages. The effect is more prolonged and has a much more specific effect upon the calcium level. A.T. 10 increases the absorption of calcium from the gastrointestinal tract and greatly increases the degree of excretion of phosphorus by the kidneys. In this respect it simulates parathyroid hormone more closely than does vitamin D. In the acute stage, A.T. 10 may be administered in a dose of 3 cc. per day followed by a maintenance dose of 1 cc. three times a week. The Sulkowich test affords a simple method of checking the adequacy of treatment. It might be well to state that the serum calcium level should be kept at low, normal or slightly subnormal. This can be readily checked by the patient doing his own Sulkowich test without the necessity of frequent serum calcium determinations.

Hormonal therapy generally has not been a satisfactory method of treatment. Parathyroid extract by the oral route is of little value, being largely inactivated by the gastric juices. Parenteral administration requires increasingly larger doses. The cause of this apparent tolerance is obscure although an antigen antibody reaction has been postulated.[8] Not only does A.T. 10 have a more prolonged effect than parathyroid hormone, but it may also be taken orally; produces no tolerance; is less expensive and is stable and remains potent at room temperature. There consequently is little use for the hormone in the treatment of parathyroid tetany.

The prognosis of hypoparathyroidism is good if the condition is recognized and managed properly prior to the onset of the chronic or trophic manifestations. This condition in the acute phase is not a fatal one, and the uncomfortable state of tetany can be promptly alleviated. Hypercalcemia, on the other hand, is a grave situation and should be avoided. If the chronic state be present, the institution of therapy apparently stops the progression even though no regression may be appreciated. Most cases are transient and, therefore, if adequately treated, very little if any ill effect may be experienced during the period that the glands are in a state of hypofunction. In most instances the patient can be adequately controlled if followed in a similar fashion to that followed in the treatment of diabetes. The patient must appreciate and have an understanding of his condition before adequate management may be carried out.

CASE REPORT

A 57 year old white man ranch hand entered the hospital on Dec. 9, 1951, complaining of pain of two weeks duration in the left shoulder. His past history and systemic review revealed no evidence of nervousness, of weight loss, and of cold tolerance. On physical examination, he appeared to be a well developed, well nourished, man who was not acutely or chronically ill. Lesions which were diagnosed as condyloma acuminata were seen on the penis and in the region about the anus. There was some tenderness in the left shoulder region on active and passive motion and in the maneuver of abduction. A smooth, non-nodular and symmetrical enlargement of the lower anterior neck was observed.

During his course in the hospital, roentgenograms of the cervical spine revealed some diminution of the size of the foramina of the third, fourth, fifth, sixth, and seventh vertebrae. A basal metabolic rate revealed plus 33 per cent. The total cholesterol was 224 mg. per 100 cc., and the cholesterol esters were 168 mg. per 100 cc. On December 15 he was started on Lugol's solution, drops 10 three times a day, and a basal metabolic rate two days later showed a value of 22. On December 19 partial thyroidectomy was done. The thyroid gland was mobilized through a collar incision with the strap muscles being divided bilaterally. The posterior superior portion of the left lobe appeared to be quite hard. Similar areas were seen in the right lobe. Approximately 5 to 7 grams of the right lobe were left even though the consistency was not normal. A less quantity of the opposite lobe was left. A routine closure and drainage completed the operation. An examination of the specimen removed did not reveal evidence of any parathyroid tissue having been included. The pathologist reported Riedel's struma.

On the fifth postoperative day the patient complained of a crawling sensation of the skin of the hands and face. At the onset of symptoms, the serum calcium and serum phosphorus levels were found to be 8.3 and 5.5 mg. per 100 cc. respectively. Intravenous calcium gluconate was administered with relief of symptoms. It was believed that the patient was in a postoperative hypothyroid state resulting from embarrassment of circulation to the parathyroid glands. He was given 50,000 units of vitamin D three times a day and calcium gluconate by mouth, 1 gram four times a day.

With the treatment employed, the patient's symptoms improved sufficiently so that approximately one month after operation he was given a two weeks leave from the hospital and was told to continue his therapy. This therapy consisted of thyroid extract 1 grain daily, vitamin D 50,000 units twice daily, calcium gluconate 1 gram five times a day, and phenobarbital ½ grain three times a day.

Although this patient had taken his medication as directed, he returned from leave complaining of tingling and a crawling sensation in the left hand. The serum calcium level was 8.9 mg. per 100 cc., and the serum phosphorus was 5.2 mg. per 100 cc. In addition to the above therapy, he was given a teaspoonful of amphojel 4 times a day and on Feb. 26, 1952 he was started on hytakerol capsules (0.625 mg. crystalline dihydrotachysterol) 1 daily. The urine was examined frequently and, although initially no calcium was found, an increasing quantity was seen after several days of therapy. The degree of clouding with the Sulkowich test was below normal, but it was believed that this was the optimum level at which he should be carried. The patient was discharged from the hospital on March 7 with instructions concerning his maintenance therapy (1 capsule hytakerol 3 times a week) and instructions for testing the urine.

This patient was seen again by readmission to the hospital on Sept. 15, 1952 complaining of numbness of the legs and tingling of the feet and hands. Physical examination showed the skin to be dry, the hair to be coarse and dry, and the general appearance of myxedema. The serum calcium was reported to be 7.8 mg. per 100 cc., and the serum phosphorus was 6.6 mg. per 100 cc. The total

cholesterol was 356 mg. per 100 cc., and the basal metabolic rate was minus 7 per cent.

Daily treatment consisted of 3 grains of thyroid extract, 12 grams of calcium gluconate, and 200,000 units of vitamin D. He gradually lost the appearance of myxedema and improved symptomatically. The Sulkowich test continued to show less than the normal quantity of calcium in the urine, and the serum calcium and serum phosphorus percentages were approximately those obtained on admission. The total cholesterol percentage fell to 218 mg. per 100 cc., and the basal metabolic rate rose to plus 19 per cent.

The patient expressed a desire to leave the hospital, and he was placed on the above outlined therapy when he was discharged on Nov. 11, 1952. Further hospital study of this patient is contemplated.

SUMMARY

A brief historical review of tetany following thyroidectomy is presented. The anatomy and physiology of the parathyroid glands is outlined.

The clinical manifestations of parathyroid deficiency, with the diagnosis and treatment, are discussed.

A case report is presented to illustrate some of the practical aspects of the treatment of hypoparathyroidism.

REFERENCES

1. Albright, F., and Reifenstein, E. C., Jr.: The Parathyroid Glands and Metabolic Bone Disease, Baltimore, Williams and Wilkins Company, 1948.
2. Albright, F.: A page out of the history of hyperparathyroidism, J. Clin. Endocrinol. *8:* 637 (Aug.) 1948.
3. Bell, G. O., and Bartels, E. C.: Postoperative parathyroid tetany, Lahey Clin. Bull. *7:* 105 (April) 1951.
4. Blum, H.: Further use of dihydrotachysterol (A.T. 10), West. J. Surg. *49:* 113 (Feb.) 1941.
5. Boothby, W. M., Haines, S. F., and Pemberton, J. deJ.: Postoperative parathyroid insufficiency, Am. J. M. Sc. *181:* 81 (Jan.) 1931.
6. Brocato, S.: Treatment of post-surgical hypoparathyroidism, New Orleans M. & S. J. *103:* 520 (June) 1951.
7. Eaton, L. M., and Haines, S. F.: Parathyroid insufficiency with symmetrical cerebral calcifications, J. A. M. A. *113:* 749 (Aug. 26) 1939.
8. Freyberg, R. H., Grant, R. L., and Robb, M. A.: Hypoparathyroidism; treatment of chronic cases, J. A. M. A. *107:* 1769 (Nov. 28) 1936.
9. Gley, cited by Reinhoff, W. F., Jr.: Lewis Practice of Surgery *6:* 306 Hagerstown, Maryland, W. F. Prior Company, Inc., 1951.
10. Haines, S. F.: Parathyroid insufficiency, M. Clin. North America *24:* 119 (July) 1940.
11. Levy, H. A.: Symposium on advances in clinical medicine; unusual clinical manifestations of chronic hypoparathyroidism, M. Clin. North America *31:* 243 (Jan.) 1947.
12. MacBryde, C. M.: Treatment of hypoparathyroidism with dihydrotachysterol, South. M. J. *31:* 720 (July) 1938.
13. MacBryde, C. M.: Treatment of parathyroid tetany with dihydrotachysterol, J. A. M. A. *111:* 304 (July 23) 1938.
14. Mikulicz, J., cited by Reinhoff, W. F., Jr.: Lewis Practice of Surgery *6:* 307 Hagerstown, Maryland, W. F. Prior Company, Inc., 1951.
15. Reinhoff, W. F., Jr.: Lewis Practice of Surgery, *6:* 308 Hagerstown, Maryland, W. F. Prior Company, Inc., 1951.
16. Shelly, D. H., and Goodman, M. J.: Calcium and phosphorus studies, J. A. M. A. *102:* 669 (March 3) 1934.
17. Siglin, I. S., Eaton, L. M., Camp, J. D., and Haines, S. F.: Symmetric cerebral calcifications which followed postoperative parathyroid insufficiency; report of case, J. Clin. Endocrinol. *7:* 443 (June) 1947.

18. Kocher, T., cited by St. Clair, W. H., Jr.: Thyroidectomy, Am. Surgeon *18:* 245 (March) 1952.
19. Swinton, N. W., and Claiborne, T. S.: Postoperative parathyroid tetany, S. Clin. North America *16:* 1601 (Dec.) 1936.
20. Vassale, G., and Generali, F., cited by Reinhoff, W. F., Jr.: Lewis Practice of Surgery *6:* 310 Hagerstown, Maryland, W. F. Prior Company, Inc., 1951.
21. Weiss, N., cited by Reinhoff, W. F., Jr.: Lewis Practice of Surgery *6:* 308 Hagerstown, Maryland, W. F. Prior Company, Inc., 1951.
22. Wolfler, A., cited by Reinhoff, W. F., Jr.: Lewis Practice of Surgery *6:* 308 Hagerstown, Maryland, W. F. Prior Company, Inc., 1951.
23. Wood, J. H., and Morris, K. A.: Severe tetany with laryngospasm and prolonged coma following thyroidectomy; report of case, South. Surgeon *15:* 705 (Sept.) 1949.

PREVENTION OF POSTOPERATIVE SHOCK

JOHN T. STAGE, M.D.*

Jacksonville, Fla.

The purpose of this paper is to discuss the prevention of postoperative shock from the viewpoint of the anesthesiologist. The discussion will cover only that period of time the patient spends in the operating room.

PERIOD OF INDUCTION

Believing that postoperative shock can be more intelligently discussed from the viewpoint of prevention than from that of treatment after its occurrence, I shall attempt to develop a pattern of conduct for carrying the average patient through a surgical procedure. The induction of the anesthesia is the first step in the pattern. If spinal anesthesia has been chosen, severe hypotension may develop immediately. Notwithstanding the ease with which vasoconstrictors can control the vascular dilatation of the area blocked by a spinal drug, too many patients still receive this type of anesthesia with no one to observe the changes in blood pressure, or with no intravenous inlet through which vasoconstricting drugs can be administered.

If an intravenous drug is chosen for induction, then speed shock may make its appearance. Speed shock arises from the too rapid introduction of drugs into the body. In the use of barbiturates, the patient experiences temporary apnea, hypoxia and hypotension. Artificial respiration will correct hypoxia and apnea. Hypotention can be controlled, if necessary, by vasoconstrictors. This type of shock need not occur if those who induce anesthesia will substitute skill for speed in the use of all intravenous agents.

If inhalation methods are chosen for induction, a stormy first stage can lead to vomiting, hypoxia, shock and cardiac arrest. This phase of the anesthetic procedure has been discussed by many writers. The more skillful and experienced the anesthetist, the more satisfactory will this period be; but a frightened, poorly medicated patient with wet mucous membranes will tax the ingenuity of even the best.

If medication has been delayed, a plea is made to supply the drugs intravenously. By this method the pharmacologic effects will be noted in a few minutes. If the drugs are given subcutaneously, their effects may not be felt until the patient is deep in anesthesia. All anesthetists fear and respect this period and should plan a program of preparedness. This program should include adequate suction equipment, catheters, a laryngoscope and endotracheal equipment, all of which should be on hand during all inductions. There may be an entity called minor surgery, but there is no minor anesthetic procedure.

* Riverside Hospital, Jacksonville, Florida.

Presented during the Louisville Assembly of The Southeastern Surgical Congress, March 9-12, 1953, Louisville, Kentucky.

PERIOD OF SURGICAL MANIPULATION

With uneventful completion of the period of induction, the period of surgical manipulation is entered. The loss of blood, handling of viscera and stimulation of autonomic nerve fibers are surgical in origin and generally are combated successfully. Blood plasma and serum albumen have proved their worth. New solutions such as dextran, polyvinylpyrrolidone (PVP) and oxypolygelatin are now being investigated clinically as temporary blood substitutes. The stigma of anaphylactic shock has been attached to dextran. This will be a real barrier to its use unless purification of the product removes this fault. Unlike dextran, PVP lacks this property and in addition causes no cross-matching difficulties following its use. It has no adverse effects on the viscera. Oxypolygelatin is nonantigenic and nontoxic, but will cause cross-matching difficulties. All of these drugs are merely plasma expanders and have no oxygen-carrying ability. They are blood substitutes until blood arrives, or like plasma, they fill a vascular tree and act as osmotic pumps.

Another valuable aid for combating shock during the period of operation or in the postoperative period is norepinephrine, which has proved to be a mysterious but fascinating drug. Despite its apparent relationship pharmacologically to epinephrine, its action is quite different. Whereas the action of epinephrine is primarily cardiac and its vasoconstricting ability is demonstrated only during topical application and peripherally in the skin, norepinephrine has no cardiac action and its powerful vasoconstriction affects in addition to other centers, the vast vascular bed present in the striated muscles. This bed is not influenced by epinephrine. The action of norepinephrine appears and disappears so quickly that it can well be referred to as a flash drug. By careful manipulation of an intravenous drip solution of norepinephrine in the strength of 0.004 Gm. per 1000 cc. (4 cc. of 0.1 per cent solution), the blood pressure can be kept at a fairly stable level. It will be noted that both the systolic and diastolic blood pressures rise. Bradycardia occurs. When the flow of solution is slowed, the fall in blood pressure occurs in a matter of seconds, unless the patient is able to sustain his own blood pressure.

Several clinical impressions have been formed from experience with norepinephrine. One is that if a patient requires a constant though small flow of this drug during operation and for some hours postoperatively, that patient should be considered dangerously ill, and an endeavor should be made to search for any unknown factor which may be prolonging the shock. Another impression gained is that, notwithstanding the teachings that vasoconstrictors have no place in the treatment of shock, norepinephrine will act on patients who are in true shock and will not respond to other vasoconstrictors, and who need sustaining until blood or plasma can be provided. Either the patient still has some vascular tree which has not been constricted in his shocked condition, or norepinephrine has an action as yet undescribed.

While busying himself correcting surgically produced shock, the anesthesiologist may be abetting the situation by his own action. If he is carrying the patient in too light a plane of anesthesia, he may well face a fluctuating blood

pressure; bouts of irregular respiratory rate and periods of cardiac irregularity. Eventually shock will supervene. If too great a depth of anesthesia is maintained, then a toxic exhausted myocardium; a drug-saturated brain and a dilating vascular tree may be unable to sustain a wavering blood pressure.

With the use of curare drugs well established, supplementary or assisted respiration is being practiced more and more. To produce good relaxation, enough drug is given with the knowledge that depressed respiratory motion or arrest will occur. To correct the depression or the apnea, manual respiration is instituted. Several errors may occur. If positive pressure is maintained during the expiratory phase, the vascular tree within the thoracic cavity is collapsed. Cardiac return flow falls, the pump becomes inefficient, and shock ensues. By now the lesson should be learned that those who give curare should be able not only to resuscitate, but in their efforts to bring about resuscitation, should copy as nearly as possible the normal respiratory motion of the patient.

If adequate respiratory exchange is not maintained, two gases may be the source of shock. Inadequate intake of oxygen leads to the well known cycle of anoxia, damaged cells, leaking vessels and injury to the central nervous system. Less well recognized is the shock produced by retained carbon dioxide. As the expiratory efforts are weakened by high spinal anesthesia, heavy doses of cyclopropane, pentothal sodium and curare, the carbon dioxide in the blood stream rises. With this rise, increasing hypertension and tachycardia occur. Tremendous concentration of this gas may be maintained in a healthy patient with no further signs than those mentioned. The baffling postoperative shock occurring after the use of cyclopropane has been explained on the basis of this mechanism. Certainly when a shift is made to nitrous oxide or to light ether at the end of operation performed under cyclopropane anesthesia, there is a remarkable lack of this type of shock. It is when the patient is returned to bed that the piled-up carbon dioxide is emptied by the respiratory motion. Loss of carbon dioxide leads to vascular dilatation and hypotension. The anesthetist attempts to escape the problem by the process of *washing out* the patient. A lighter or a more irritating type of anesthetic agent is employed so that the blood stream will empty itself of this gas.

The misuse of the endotracheal tube may well initiate shock. There is a *child-like* belief that a tube in the trachea is a guarantee of satisfactory endotracheal anesthesia. A tube filled with mucus; a kinked tube; or the bevel of the tube against the tracheal wall may only guarantee early death. It must also be remembered that the endotracheal tube removes the natural barrier of the vocal cords. Its removal leaves the patient helpless against a thoughtless anesthetist who persists in dipping into an endotracheal tube with a catheter; forgetting that prolonged periods of suction deplete the supply of oxygen with ensuing shock and cardiac arrest.

PLANNING FOR IMMEDIATE POSTOPERATIVE PERIOD

As the closing sutures are being placed, the anesthetist plans ahead for the immediate postoperative hours. The anesthesia level is lightened. Intravenous

inlets are secured so that movements of the patient will not dislodge them. If necessary, norepinephrine or other vasoconstrictors may be continued as an intravenous drip until the vascular system has re-established its stability. A depot procaine blocking solution such as Efocaine may be used at this time to reduce postoperative pain. If this depot solution is placed around the field of operation, the patient will require less opiate, and the shocking effects of both pain and opiates may be counteracted.

The operative period is now completed. If the patient has been carried successfully through this period without shock; if the plane of anesthesia is light; and if he has had adequate replacement of fluid, then one may say, with caution of course, that this patient should not suffer from immediate postoperative shock.

It is heartening to realize that the future is already holding out bright promises. The use of drugs which block the autonomic nervous system, such as hexamethionium chloride, will produce a relatively bloodless field in selected cases. ACTH and cortisone should soon play a larger part in the preoperative and postoperative support of a flagging adrenal gland in the surgical patient.

SUMMARY

The problem of postoperative shock actually begins in the preoperative period. If discussion of the preoperative period is omitted for the sake of simplicity, then the operative and postoperative periods must be dovetailed. A review of the mechanisms producing shock maps the course the anesthesiologist must follow. Induction of anesthesia should be physiologic. Maintenance should be carried out at only the necessary depth. Oxygen saturation of the blood stream should be at the highest possible level at all times. The tone and volume of the vascular tree must be maintained. Those agents which can be classified as shock preventers are rare, being limited to three plasma expanders, dextran, polyvinylpyrrolidone and oxypolygelatin, and a new vasoconstrictor, norepinephrine.

SURGICAL LESIONS OF THE NECK

ARNOLD S. JACKSON, M.D.

Madison, Wisconsin

Of the surgical lesions of the neck, the most important of the many varied conditions encountered is goiter. It is most important, because it is most commonly encountered even in nonendemic goiter sections of the country.

From a surgical standpoint, our treatment of the goiter problem has had but a few changes in several decades. The technic of thyroidectomy is essentially the same, although some surgeons, notably the Lahey group, routinely prefer to isolate the recurrent laryngeal nerves. The preoperative preparation of hyperthyroid cases has undergone some change, the one great advancement being the use of antithyroid drugs in cases of advanced toxic nodular goiters. This contribution has proved lifesaving in many cases formerly considered poor surgical risks, yet we still find it necessary to stop the antithyroid drug 10 days prior to operation and substitute iodine in order to curtail bleeding and simplify the operation.

What about the diffuse toxic variety commonly termed exophthalmic goiter? We have learned that the antithyroid drugs are not the answer, at least in adults, and so for the past four years we have abandoned their use. There would be no objection to using them if one were dealing with a long standing and very toxic case, or one of the mixed type where some doubt existed as to the diagnosis. In recent years I have abandoned the use of antithyroid drugs on these cases, and have gone back to preparing patients with Lugol's solution for 10 to 14 days before operation, with one exception. In children where time is not a matter of economic importance, I have been conducting a six year study on a group to ascertain whether or not it was possible to cure these children without operation. About a dozen children ranging from 5 to 15 years of age are under observation, and are receiving either propylthiouracil or tapazole. I see no great advantage in either, but occasionally one will appear to be better tolerated than the other. In an experience in the use of these drugs in over 700 cases of hyperthyroidism in both children and adults, no instances of agranulocytosis have occurred. This I attribute to the avoidance of large doses, advocated by some, and to frequent and close observation of the patient. A 16 year old girl under treatment a few weeks ago, had the annoying complication of a skin reaction which developed not only from the antithyroid drugs but from iodine as well. I had hoped to treat this child nonsurgically, but I was forced to hurriedly prepare her with Lugol's solution and pyribenzamine for operation.

To date the results of the antithyroid drugs have not been encouraging, and

From the Jackson Clinic, Madison, Wisconsin. Read during the meeting of The Southeastern Surgical Congress at Louisville, Ky. March 10, 1953.

Presented during the Louisville Assembly of The Southeastern Surgical Congress, March 9–12, 1953, Louisville, Kentucky.

yet the first case, and one of the most severe in the series, remains in perfect health with a basal metabolic rate (BMR) of minus 10 per cent, three years after stopping all medication. Some of the children have remained well for as long as six months after withdrawing the drug, and then have slowly relapsed and required further medication. Most of the children run normal metabolic rates, gain weight, carry full school duties, and are the picture of health while on drug therapy.

What about radioactive iodine? Is it the drug of choice in large thyroid clinics? No. The first great wave of enthusiasm that greeted I-131 has considerably subsided just as it did for roentgenotherapy 30 years ago and for the antithyroid drugs more recently. More and more cases of failure to cure, with only partial control of symptoms, are being reported. The ultimate effect of I-131 is still unknown, although no instance of malignancy, developing from its use, has been recorded. This possibility seems improbable. Some unbiased observers have reported series of cases with very favorable results from the use of I-131 in exophthalmic goiter. And it has proved especially effective in treating complicated cases such as the aged, when the heart is severely damaged, or when nerve injury has occurred. One must decide for his patients as he would for his family, whether he would prefer a thyroidectomy performed by a competent surgeon or treatment with I-131 by a competent physicist.

In my opinion, I-131 has no place in the treatment of nodular goiter but in malignant lesions of the thyroid it has given some encouraging results although I know of no reported cures. In the papillary adenocarcinoma type, formerly termed by some aberrant thyroid lesions, a total lobectomy of the involved lobe with removal of all involved glands on the same side and a partial thyroidectomy of the opposite lobe is the method of choice. In the Hürthle's cell variety, another form of rather low grade malignancy, surgery is effective also, but in the diffuse adenocarcinoma group, I-131 holds the promise of doing something that surgery and roentgenotherapy cannot do.

More than the allotted time could be devoted to the subject of intrathoracic goiter, the problems concerning the diagnosis, and surgical removal of these tumors, and I shall not discuss them in this paper. Instead we should briefly consider a few of the 40 or more surgical conditions occurring in the neck. Obviously it is impossible to do more than refer to some of these conditions. For more detailed study one is referred to the splendid text of Ward and Hendrick on this subject.

Parathyroid tumors are rare, but if one is on the lookout for them they may occasionally be detected especially when they are associated with renal calculi and hypercalcemia. They may be either benign or malignant.

In the salivary glands are found calculi that often cause painful conditions. In some instances the stones may be removed by probing and dilating the ducts. The mixed tumor of the parotid gland is the most common and most important lesion of this group. If detected early, and surgically removed before the capsule has been invaded, cure is simple and effective. When they have ruptured through the capsule and deeply invaded the gland, one or more branches of the facial

nerve may have to be sacrificed. Although they recur only locally, the patient's chances of permanent cure are greatly lessened. Recently I operated upon a very rare lesion of the parotid gland, a hemangio-endothelioma, occurring in a 24 year old man. Cysts are uncommon and are not difficult to remove.

There is a group of pathologic conditions in the neck that metastasize from the buccal cavity or from below the clavicle which may require surgical removal to prolong the patient's life.

Of the large group of benign surgical lesions of the neck, the most important are the lipomas, fibromas, chondromas, dermoids, myomas, hemangiomas, lymphangiomas, keloids, cylindromas, and xanthomas. To this group one might also add the sebaceous and atheromatous cysts and the adenomatous goiters. The removal of all these lesions is a comparatively simple surgical procedure that may be done under local anesthesia.

Next I have classified a group of unusual tumors such as those of the carotid body, neuroblastomas, neurofibromas, ganglioneuromas, Boeck's sarcoid and Mikulicz's disease. In recent years, having encountered 2 of these rare cases, I have been especially interested in this last condition. There are probably less than 100 authentic cases of Mikulicz's disease reported in the American literature. Most of the published cases are Mikulicz's syndrome, and include such conditions as leukemia and tuberculosis, with secondary involvement of the salivary glands. No one has ever improved on the classical description of this disease as given by Mikulicz in 1888, namely a symmetrical involvement of the salivary glands, a narrowing of the palpebral fissures and a parchment-like dryness of the tongue. If one will memorize this triad of signs and keep in mind the characteristic appearance, these cases that have so often been overlooked will be recognized. In the past they have generally been treated by surgery or roentgenotherapy. The first of my cases, however, responded favorably to penicillin and was the first report of such therapy in the literature, but the second, being of long standing, required surgical removal of both submaxillary glands.

Boeck's sarcoid is a surgical condition only in that tissue for biopsy is required to establish a diagnosis, and in particular to rule out the possibility of Hodgkin's disease. In contrast to the latter, this entity is benign and requires no particular therapy.

A carotid body tumor is another unusual condition that for many years was considered malignant. Though this may be true, its rate of growth is protracted so that patients may live for years. The tumor is so slow to invade the carotids that its early diagnosis may permit removal without too great a risk. The external carotid is involved first, but when the common carotid becomes invaded, ligation of this vessel in older persons is attended with a high mortality. Clinical recognition of these tumors is not always easy, since they may simulate a sarcoma by pushing forward the sternocleidomastoid muscle.

There is a large group of conditions of the neck that were formerly looked upon as surgical lesions, namely the inflammatory diseases. These lesions more and more are being treated by antibiotics and other forms of therapy. In this list are found, actinomycosis, blastomycosis, sporotrichosis, Ludwig's angina, tubercu-

lous lymphadenitis, and non-suppurative and suppurative lymphadenitis. The important thing in all of these conditions is to establish a correct diagnosis and then institute the proper treatment.

Finally there is the relatively common group designated as cysts, the branchial and thyroglossal, both congenital, and both benign or malignant. I have operated upon two malignant branchial cysts, but all of the thyroglossal group that I have seen have been benign. However, Byrne[1] recently reported a case of a carcinoma in a 44 year old Negro woman. Likewise, Hendrick,[2] reported that he had recently encountered a similar case. It must be concluded that this complication is exceedingly rare.

Malignant degeneration occurring in a branchial cyst is more commonly observed and is one reason why these cysts should be removed. Another reason is that in later years they may start to grow and become firmly attached to the deep structures of the neck, thus being more difficult to remove. As a rule, they are not difficult to diagnose, as they lie beneath the sternocleidomastoid muscle, and tend to push this forward. Once, however, I thought I was dealing with a malignant lesion, probably a sarcoma, in a young man, only to have it prove to be a calcified branchial cyst.

Thyroglossal cysts by contrast, are located in the midline of the neck, and to cure them one must follow the cyst tract up to the hyoid bone. If it extends above this bone, a section of the middle of the bone must be removed, and the tract completely excised to the base of the tongue. Otherwise it will recur. Once I was pleasantly surprised, to find that an anticipated lengthy operation proved to be only a matter of a few minutes, since the expected midline cyst proved to be a lipoma. Which goes to show that lipomas may be found almost any place.

Thyroglossal sinuses are rare. I have seen only one which occurred in a young man who complained of a discharging sinus above the right clavicle, and an occasional bitter taste in his mouth. Complete excision of this sinus tract resulted in a cure.

Then there are the hygromas of infants and children. Their removal is a rather formidable surgical procedure. This is the only one in which I have used a general anesthetic, all others being done under nerve block anesthesia. There are also the rare epidermal lesions and finally the only recorded cases I could find in the literature of a hemangioendothelioma of the submaxillary gland.

CONCLUSIONS

1. Surgical pathologic conditions found in the neck may be divided into seven major groups:

   a. Tumors of the thyroid and parathyroids.
   b. Tumors of the salivary glands.
   c. Secondary tumors of the neck.
   d. Benign tumors.
   e. Unusual tumors.
   f. Cysts and fistulas.
   g. Inflammatory lesions.

2. Thyroid tumors are the most common and most important group. The surgical treatment of the various types of goiter are considered.

3. Tumors of the salivary gland are important in that their early diagnosis and removal before invasion of the capsule will effect a cure.

4. Rare lesions, such as Mikulicz's disease, are reviewed and 2 cases of this condition are reported.

5. Congenital cysts are usually benign, but may become malignant.

6. Inflammatory lesions may require operation and antibiotics.

REFERENCES

1. Byrne, J. J.: Management of intestinal obstruction, Boston M. Quart. *3:* 33 (Sept.) 1952.
2. Hendrick, J.: Personal communication to the author.

THE SURGICAL REPAIR AND REHABILITATION OF THE CLEFT PALATE AND HARELIP PATIENT*

G. Turner Howard, Jr., M.D., F.A.C.S.

Knoxville, Tenn.

The modern management of cleft palate and harelip defects demands their surgical correction first, but also must include the total rehabilitation of the patient. This involves several fields of endeavor. There must be close cooperation between the surgeon, pediatrician, dentist, orthodontist, prosthodontist, speech therapist, otolaryngologist and sometimes the psychiatrist.

Nothing can be more pitiful than to see neglected children who are occasionally seen in the clinic and who have been allowed to keep their disfiguring defects until after they have started to school. No one can be as cruel as one child to another. The jeers and taunts suffered by these children often leave permanent scars on their personalities. Hence, the later the problem is attacked the more complex it becomes. Even a good psychiatrist may never heal these children's warped personalities. Many of then refuse to speak, and others are extremely unhappy, seeking to hide in a corner or to run away. Anyone who has been associated with this problem must make a strong plea to have these defects corrected early.

INCIDENCE AND ETIOLOGY

The incidence of harelip and cleft palate defects seems to vary somewhat in different areas. Barsky[1] states there is an incidence of about one per 1,000 births. In a series of 1,000 cases he found 749 unilateral and 251 bilateral clefts. Ivy[5] reports one cleft lip or palate for every 762 births in Pennsylvania. This state has a program of rehabilitation for these unfortunate children similar to that of Tennessee. It is believed that more states should take an interest in this important problem. It is interesting to note on the accompanying map how the incidence of these defects varies from county to county in the State of Tennessee, the rural areas showing the highest incidence (chart 1).

In the formation of the harelip and cleft palate there is a failure of normal fusion of a part or all of the fronto-nasal and maxillary embryonic processes. Various factors have been mentioned as possible causes of these conditions, such as alcoholism, syphilis, malnutrition, and lack of oxygen in utero.[5] However, heredity seems to be the most important single factor. Padgett[6] reports 20.4 per cent incidence of a known inheritance factor. Hereditary factors have been traced in 23.6 per cent of our cases.

TREATMENT

Since these conditions have been known and described since ancient days, attempts at treatment also date from antiquity. It was Galen who gave the

* From the Cleft Palate and Harelip Clinic, East Tennessee Crippled Children's Hospital, Knoxville, Tenn.

deformity the name of *lagocheilos* meaning *lip like a hare.*[4] The operation described during the time of the Crusades consisted of *cutting the false edges of the lip and sewing with silk.*

Carl Ferdinand von Graefe, a German surgeon in 1816, was considered the founder of Plastic Surgery. Dieffenbach, Labat, Blandin, Serre, vonAmmon, Jobert, Nelton, Zeis and others quickly followed. Sir William Ferguson and von Langenbeck greatly influenced the treatment of the cleft palate. Mirault and Hagedorn advocated a "Z" type closure of the lip to avoid the contracture that may follow the vertical closure and to obtain the normal outward pouting of the lip.

Blair and Brown[2] urged better cleft lip repairs and stressed the importance of including the nasal deformity in the general plan of correction. The Blair and Brown modification of the Mirault operation became the operation of choice in many centers and is the one used by the author.

NUMBER OF CHILDREN WITH CLEFT PALATE AND/OR HARELIP PER 100,000 POPULATION ON CRIPPLED CHILDREN'S REGISTER AS OF JANUARY 1, 1952 BY COUNTIES OF TENNESSEE

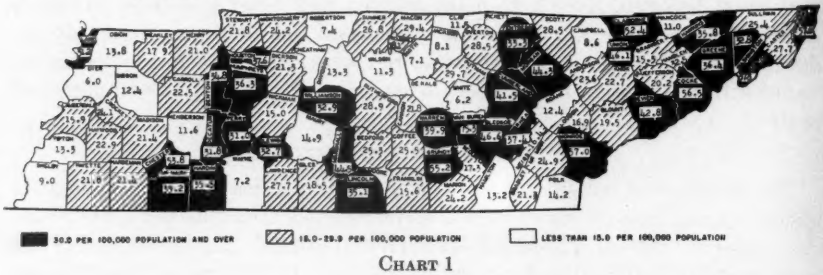


CHART 1

Despite objections raised by some authors[3] the von Langenbeck operation has proved to be the most widely accepted of the various procedures for repair of the cleft palate and the most satisfactory in our hands. Even though a part of the nasal portion of the cleft is left to granulate in with this operation, still it is much preferred to the push back operation of Dorrance and the pharyngeal flap procedures described by others.

The optimum time to operate upon these patients is somewhat disputed. However, most surgeons believe that the lip should be repaired first because the pressure of the normal functioning lip will help close the alveolar cleft to a great degree. Although some advocate the closure of the lip in the first 48 hours of life, we believe the child needs to gain back its birth weight and be in good condition for this relatively major procedure. We prefer to do the operation about the age of three months. The palate should be repaired before the child learns to speak so that faulty speech habits are never formed. We elect to do the palate operations between 9 and 11 months of age.

The preoperative management of these conditions is of the greatest importance. It is exceedingly important that these children have proper nutrition and vita-

min intake, particularly vitamin C which is so important to wound healing. They are admitted to the hospital two days before operation for a careful check-up by the pediatrician, and preoperative preparation. Many have chronic ear infec-

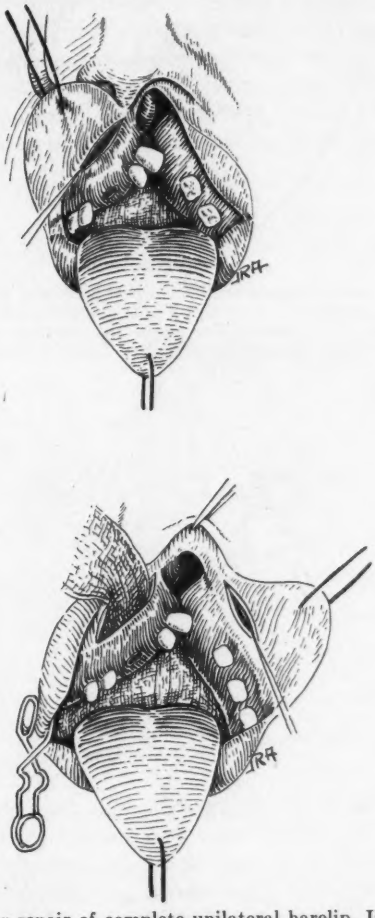


FIG. 2. Operation for repair of complete unilateral harelip. Initial incisions are made in the mucobuccal fold on either side. These incisions extend up into the lining of the involved nostril and the nose and cheeks are undermined. Harelip clamps are applied.

tions and consultation with an otolaryngologist is sought when deemed advisable by the pediatrician. A roentgenogram of the chest is ordered routinely and penicillin is started before operation to reduce the bacterial flora in the mouth even if the child does not have a cold. No palate or lip operation is done in the presence of an upper respiratory infection. A clysis of normal saline is given two hours before operation and blood is given if indicated.

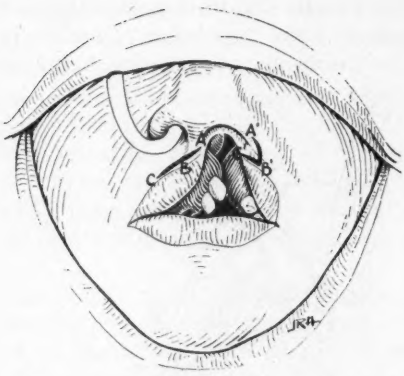


FIG. 3. After careful measurements with a caliper, incisions in the lip are made. A B equals A^1 B^1 and B C equals B^1 C^1 in distance. The triangular piece of skin on the involved side will fit into the floor of the nostril. The actual incisions are carried through the full thickness of the lip, care being taken to preserve the delicate vermilion border.

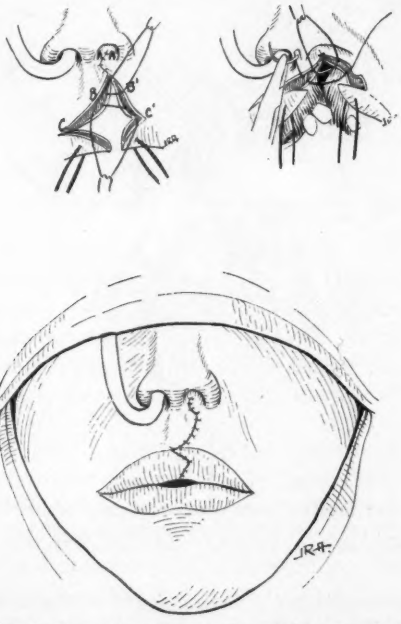


FIG. 4. The top right illustration shows the suturing of the musculature with chromic 000. The top left illustration shows the further accurate placing of lip sutures. The lower illustration shows the completed operation after the vermilion border on the involved side has been notched to receive the pointed portion of lip from the other side, thus giving a smooth normal appearing lip.

OPERATIVE TECHNIC

Before the operation is started, a long silk suture is placed in the tongue for traction and to prevent obstruction of the airway. However, this is not done in the occasional case where intratracheal anesthesia is used. The tissues of the lip, cheek and nose are undermined through an incision in the mucobuccal fold on each side. The undermining is more extensive on the side of the cleft. Harelip clamps are applied to each side (fig. 2). The nasal tip is freed on the side of the cleft through an incision made through the lining of the nostril. The thickness of the distorted ala is reduced by excision of some of the subcutaneous tissue. In

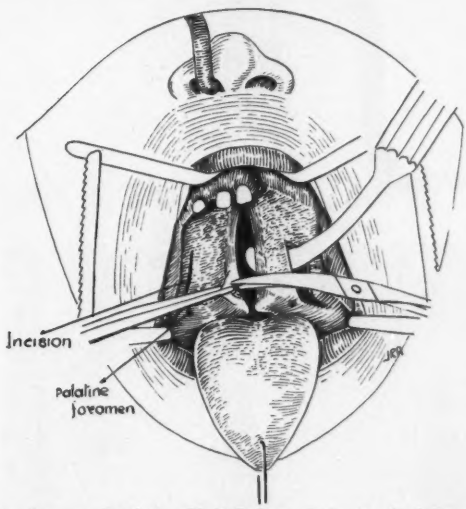


FIG. 5. Operation for repair of the Cleft Palate. Relaxing incisions are made on either side and the mucoperiosteum is elevated avoiding injury to the palatine artery. This illustration also shows the aponeurosis being cut with scissors posterior to the hard palate to allow the palate to fall forward.

some cases it is necessary to not only trim the cartilage down but to rotate it upward and inward to be sutured in a more normal position. The lip incisions are carefully measured with a caliper so that component parts of each side of the cleft will meet accurately (fig. 3).

The first incision is made through the lip along the vermilion border on the normal side extending along the cleft from the top to the philtrum of the uninvolved side. On the side of the cleft the incision starts at the lateral border of the nose, then curves downward and slightly inward for a distance of one-half of the incision on the normal side. Next the incision is carried obliquely back to the vermilion border to correspond with the lower half of the incision on the normal side (fig. 3). The vermilion border is then separated from the cleft and small silk sutures are placed in the vermilion border on each side to facilitate handling and avoid picking up the lip numerous times with the forceps (fig. 4).

The muscularis is united with chromic no. 000 suture, A to A^1, B to B^1, and C to C^1, the triangular piece of skin at the top of the defect on the cleft side fitting into the floor of the nostril. The lining of the nostril is sutured with a few sutures

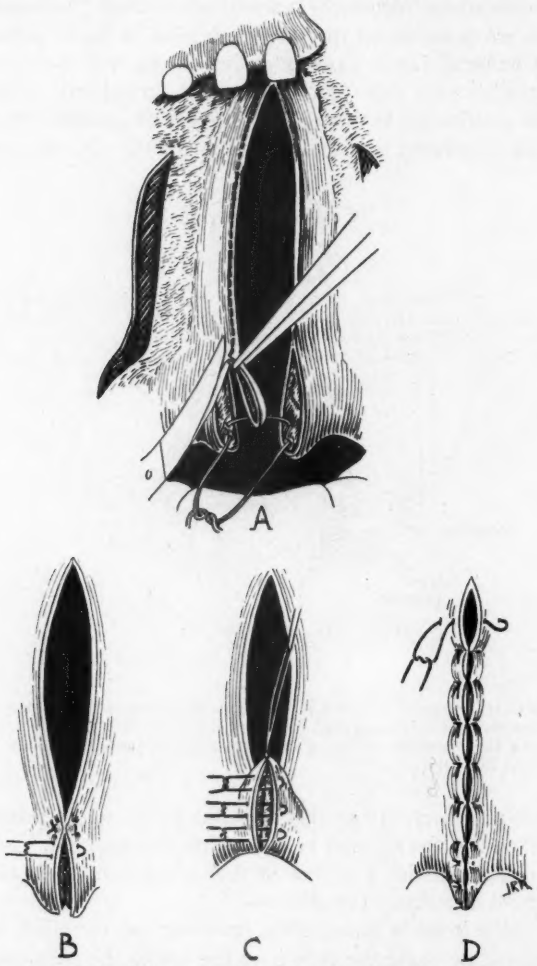


FIG. 6A. The edges of the cleft are freshened by trimming with scissors and the musculature is sutured with chromic 000 catgut. B. The soft palate is sutured with everting mattress sutures. C. The posterior portion of the soft palate is sutured using the suture in the tip of the uvula for traction. D. The mucoperiosteum and anterior mucosa is sutured.

of no. 0000 silk and that side of the nose packed with zinc oxide ointment impregnated gauze. The skin of the lip itself is sutured with interrupted no. 0000 silk. The vermilion border of the lip is trimmed down and the involved side is notched to receive the pointed end of the uninvolved side (fig. 4). In wide clefts

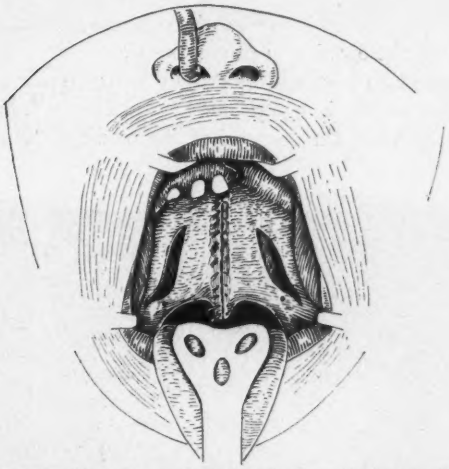


FIG. 7. Completed operation. No pack is left in the relaxing incisions unless there is still ooze from these incisions at the conclusion of the operation.

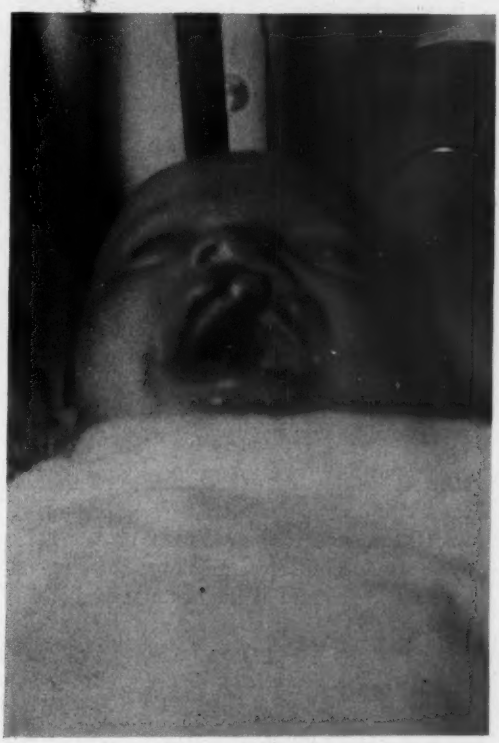


FIG. 8. L. S. C. Complete harelip and cleft palate with wide separation and marked nasal deformity.

occasionally a mattress suture is carried through the floor of the nostril on the involved side to hold the opening in proper position.

We prefer the operation described by Barsky for the repair of the double harelip in which the premaxilla is repositioned by obliquely fracturing the vomer process and using many of the features of the modified Mirault operation for the single harelip.

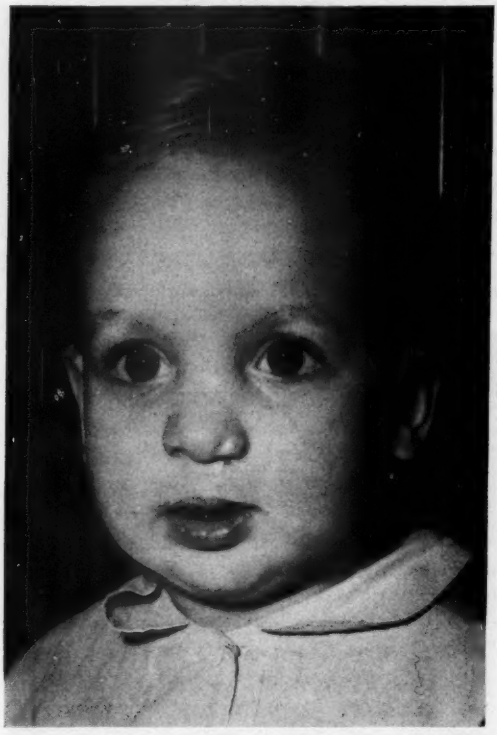


FIG. 9. L. S. C. Five months after repair of harelip

The technic of cleft palate repair has been described by many authors. The modified von Langenbeck operation preferred by us is simply described. A relaxing incision through the mucoperiosteum is made on each side starting anterior to the first molar tooth a few millimeters medial to the gingival margin (fig. 5). These incisions extend backward and at the maxillary tuberosity curve outward and backward. The mucoperiosteum is elevated through these incisions with right and left angled elevators. The prying motion strips the mucoperiosteum backward, and lifts the palatine artery from its groove in the bone. Care is taken not to injure this artery. The relaxing incisions are packed with oxycel gauze soaked with thrombin to control bleeding.

Next the palatal aponeurosis and nasal mucosa at the posterior edge of the hard palate is divided with curved scissors allowing the soft tissue flaps of the palate to drop down to a more horizontal plane at a lower level and meet in the midline (fig. 5). The mobility of the flaps are tested and if they come together without tension the edges of the cleft are freshened by paring off a thin strip with curved scissors (fig. 6).

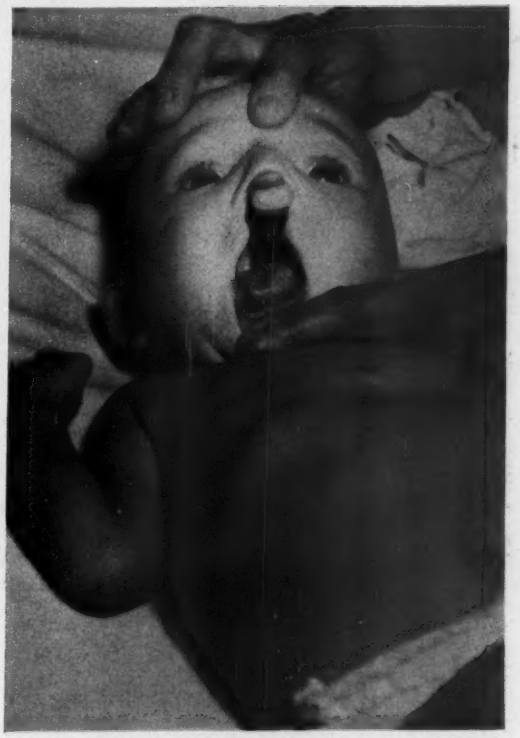


FIG. 10. C. M. Bilateral cleft palate and harelip

The last step is the suturing which is done in layers. The first suture unites the palatal aponeurosis at the junction of the hard and soft palate with no. 000 chromic catgut. Two or more similar sutures are taken to unite the muscularis of the soft palate (fig. 6). The tip of the uvula is then sutured with no. 000 silk and the suture is used for traction while the mucosa on the nasal surface of the soft palate is sutured (fig. 6 C). The oral surface of the soft palate is sutured with everting mattress sutures of silk as is also the mucoperiosteum. Usually at the end of the operation the packing is removed from the relaxing incisions. If there is no bleeding, it is left out. If there is still some ooze, the packing is reapplied (fig. 7).

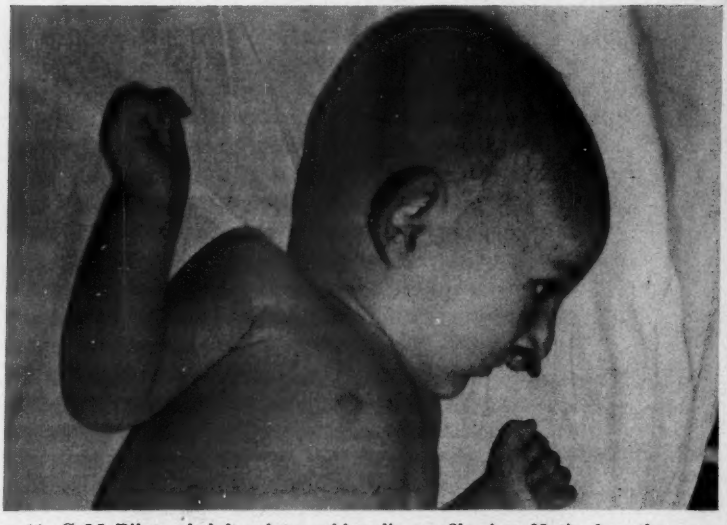


FIG. 11. C. M. Bilateral cleft palate and harelip, profile view. Notice how the premaxilla protrudes beyond the tip of the nose.

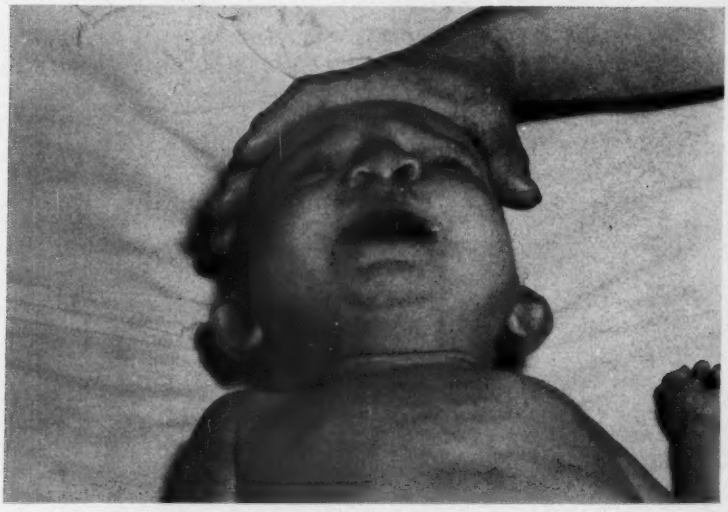


FIG. 12. C. M. Bilateral cleft palate and harelip two weeks after repair of the lip

POSTOPERATIVE CARE

These children are usually given a clysis of normal saline immediately following operation and started on a liquid diet as soon as tolerated. No suction is allowed. They are fed by a dropper, spoon or cup. Arms are restrained at the

elbows by splints to prevent them from getting their hands to their mouths. They are all given postoperative antibiotic therapy and vitamin C intramuscularly for a few days to promote firm and immediate healing. The lip sutures are removed in five to seven days and the palate sutures in 11 to 13 days. These children are all carefully followed-up for possible dental, orthodontic or speech therapy.

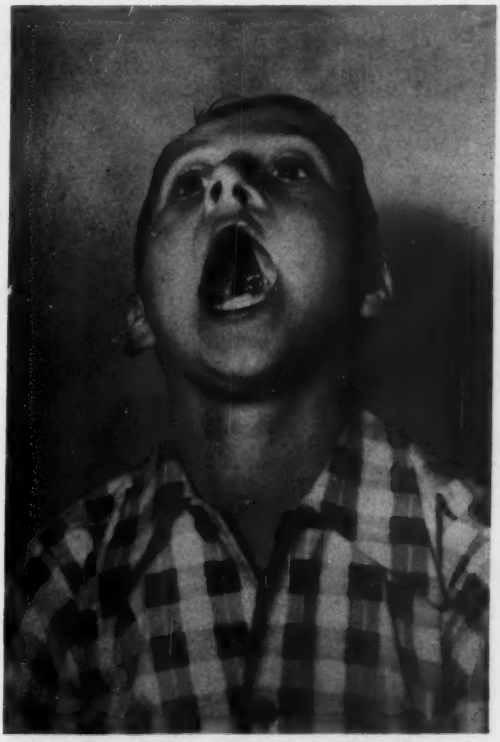


FIG. 13. J. Y. Cleft palate, preoperative photograph

RESULTS AND COMMENT

Since the program was started at the East Tennessee Crippled Children's Hospital in August 1950 there have been 77 operations done by four surgeons for harelip and cleft palate defects. Of these 77 cases 43 have been in males and 34 in females. In 15 of the cases a careful dietary history was taken of the mother for the duration of the pregnancy. In 7 there was marked nausea and vomiting. Of the remaining 8, 2 had very deficient diets.

There were 58 of the author's cases in the series of 77 operations. Of these 22 were harelips and 36 cleft palates. Of the 36 cleft palates operated upon there were 26 primary repairs, three of which were bilateral. There were 10 secondary repairs, several of which had five or more previous attempts at closure elsewhere,

and 1 had had nine previous operations. One of the secondary procedures broke down due to the child's obtaining something hard to suck on, and one of the primary operations partially separated due to anemia and an upper respiratory infection considered to be an allergy, both cases being subsequently repaired. Of the whole series of lip and palate repairs one death due to cardiac arrest occurred at the termination of an uncomplicated cleft palate repair.

FIG. 14. J. Y. Cleft palate, two weeks after operation

SUMMARY

A program for the complete rehabilitation of the harelip and cleft palate patient has been outlined. Close cooperation between the surgeon, pediatrician, dentist, orthodontist, otolaryngologist, and speech therapist is essential. If the cleft palate is successfully operated upon early enough, the patient rarely has any speech impediment, because the child learns to talk correctly from the first and has an adequate and mobile palate. However, if the repair is done after the child learns to speak, faulty speech habits are inevitable and are sometimes very difficult to overcome with the best of speech therapy. Most of these children will have faulty tooth development. Some may require extractions and prostheses.

Some will require orthodontic treatment and a few with severe scarring will require speech bulbs constructed for proper speech, all of which requires the closest cooperation with competent dental consultants. The routine administration of antibiotics and vitamin C is believed to aid quick and solid wound healing in these patients.

The nasal deformity should be corrected by all means at the time the lip is repaired. Every effort should be made to operate upon these deformities early, but these children should not be operated upon until they can withstand a relatively major procedure.

REFERENCES

1. Barsky, A. J.: Plastic Surgery, p. 185, Philadelphia, W. B. Saunders Company, 1938.
2. Blair, V. P., and Brown, J. B.: Mirault operation for single harelip, Surg., Gynec. & Obst. *51:* 81 (July) 1930.
3. Conway, H.: Combined use of push-back and pharyngeal flap procedures in management of complicated cases of cleft palate, Plast. & Reconstruct. Surg. *7:* 214 (March) 1951.
4. Davis, A. D.: Management of wide unilateral cleft lip with nostril deformity; collective review, Plast. & Reconstruct. Surg. *8:* 249 (Sept.) 1951.
5. Ivy, R. H.: Modern concept of cleft lip and cleft palate management, Plast. & Reconstruct. Surg. *9:* 121 (Feb.) 1952.
6. Padgett, E. C., and Stephenson, K. L.: Plastic and Reconstruction Surgery, p. 360, Springfield, Charles C. Thomas Company, 1948.

FLUID AND ELECTROLYTE BALANCE IN THE SURGICAL PATIENT

RICHARD S. WILSON, M.D., FURMAN T. WALLACE, M.D.
AND JAMES A. WHITING, M.D.*

Spartanburg, S. C.

Knowledge of the physiology of water and electrolytes in the body has increased tremendously in the past 10 years. Care of the surgical patient through management of fluid and electrolyte balance is best approached by asking three questions:

1. If the patient is deprived of oral intake, what should I give the patient?
2. What are the patient's losses as a result of his disease or operative procedure?
3. What deficiencies does the patient have at the time he comes under my care? The purpose of this article is to discuss the solution of these problems.

No substance is of greater importance to the human organism than water, since it comprises 61 per cent of the total body weight, and is fundamental in every physiologic process. Women have been found to have 10 per cent less body water than men. This is attributed to an inverse proportion of fat to body water.[2] The total body weight of infants averages 70 per cent to 80 per cent of water.

The use of isotope dilution methods has made available valuable information concerning the determination of total body water and the relation of body fluid compartments. Deuterium oxide (heavy water) appears to be an excellent tracer substance for water.[5]

After normal entrance through the gastrointestinal tract, water passes into two major compartments: 1. The intracellular fluid spaces. 2. The extracellular fluid spaces. The intracellular fluid accounts for 40 per cent of the body weight, of which 70 per cent is contained in skeletal muscle. The extracellular fluid is generally regarded as accounting for 20 per cent of body weight. Of this 5 per cent is plasma and 15 per cent is interstitial fluid.

To evaluate properly the patient's status preoperatively or postoperatively an understanding of electrolytes is essential. The largest portion of inorganic salts of the body by far includes sodium, potassium, magnesium, and calcium as cations or positive ions, and chloride, bicarbonate, sulfate, and phosphate as anions with negative charges. The concentration of ions must be expressed in terms in which one electrical charge is equal to another. The term milliequivalent (mEq) satisfies these requirements and gives a measure to calculate the quantity of ions in a given weight of material. Sodium is the dominant cation in plasma and interstitial fluid, whereas potassium is the dominant cation in the cell. Total body sodium and potassium have been measured by the radioactive isotope di-

From the Department of Surgery, Spartanburg General Hospital, Spartanburg, South Carolina.

* Fellow, The Wallace Foundation.

Presented during the Louisville Assembly of The Southeastern Surgical Congress, March 9–12, 1953, Louisville, Kentucky.

lution method. The number of exchangeable milliequivalents of sodium and potassium in the human body have been found to be approximately the same.

The measurements of the total chemical content of the body are a fundamental guide to the problems of surgery. Let us consider individually the three questions proposed earlier:

1. *If the patient is deprived of oral intake, what should I give the patient?* There are baseline requirements to meet the fluid losses in urine, respiratory evaporation and perspiration. Although the necessary products of metabolism in a healthy efficient body could be excreted in 500 cc. of urine, most of the patients who

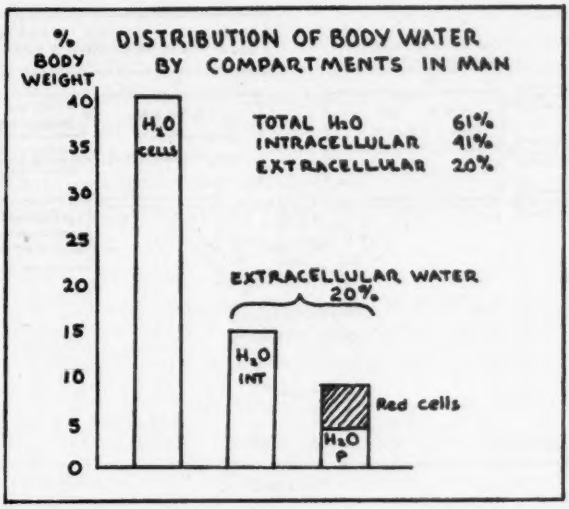


CHART 1

undergo major surgery are advanced in age, and their renal function is diminished by arteriosclerosis and actual reduction of functional nephrons. Therefore, in the postoperative period the surgeon prefers a urinary volume of more than 1000 cc. in 24 hours. Detailed studies have indicated that an intake of 800 to 1000 cc. of fluid daily is necessary to provide for the insensible losses. To prevent dehydration and loss of fluid balance it is apparent that the total baseline water intake must be between 1800 and 2500 cc. each day.

Electrolyte requirements are satisfied in most cases by a maximum of 500 cc. of isotonic sodium chloride solution (0.9 per cent) for 24 hours. The remainder of the baseline fluid requirements is made up of nonelectrolyte solutions. Dextrose is the predominant nonelectrolyte substance used in the body and contributes toward nitrogen balance, sparing of body water, and reduction of renal excretion load. When administered rapidly, glucose is not utilized. Fructose or invert sugar recently has been found to be more readily available in solution

than similar concentrations of dextrose. Dextrose is commonly administered intravenously in 5 per cent solution.

In patients who are found to be responding poorly in the postoperative period, notwithstanding the administration of sodium chloride, dextrose or fructose, and fluid, the syndrome of potassium deficiency should be considered.[3]

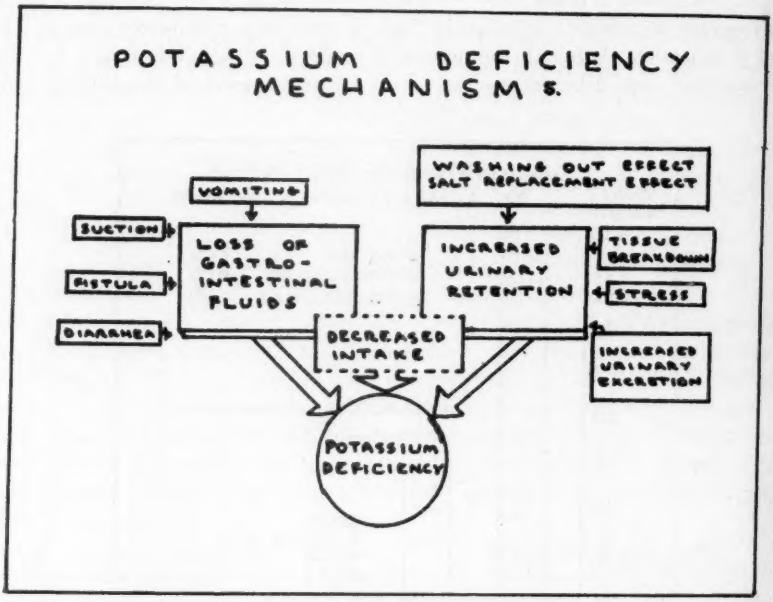


CHART 2

A diminished intake and increased output of potassium can result in muscular weakness or even paralysis, abdominal distention, and lethargy. The syndrome usually appears between the fourth and seventh postoperative days. The electrocardiographic changes are characteristic in severe potassium deficiency, and reversal of abnormal tracings closely parallels the clinical response.[8] Treatment consists of oral administration of potassium chloride or intravenous potassium phosphate. Caution must be exercised in cardiac conduction disturbances, and administration of potassium is contraindicated in acute dehydration and renal failure. The presence of oliguria is not necessarily a contraindication but merely calls for more careful and slow administration.[4]

2. *What are the patient's losses as a result of his disease or operative procedure?* This is the dynamic loss which has been described by Selye as the *alarm reaction.* Fluid shift occurs, sodium and water are hoarded, and potassium is excreted in excess. In minor surgical procedures, the fluid compartment changes resolve by the third or fourth postoperative day. After a major operation, a week or more may be required for stabilization.

Coller warns that the postoperative patient is intolerant to the administration of sodium chloride.[1] Recently ammonium chloride solution was advocated for replacement of chloride. Chloride loss may result in tetany and death, and usually occurs with high gastric chloride loss. Electrolyte stores may likewise be depleted by enterostomy.

3. *What deficiencies does the patient have at the time he comes under my care?* Obstruction with vomiting, diarrhea, and hemorrhage may lead to a state of *chronic shock*. This is static debt and can best be evaluated by blood volume determination. The values of hemoglobin, hematocrit, and red blood cell determinations are grossly inaccurate and inadequate in such cases, and even the amount of body weight loss is a better indication of the deficiency. While blood volume determinations are subject to some error, they constitute our best test. The Evans blue dye test for circulating blood volume serves as a practical procedure adaptable to the average small hospital. Direct measurement of sodium and potassium is possible by use of the flame photometer.

Although parenteral replacement is a valuable aid, in controlling metabolic imbalance, it is at best inadequate and should be considered a temporary substitute for normal oral ingestion of food and water for natural utilization by the gastrointestinal tract.

REFERENCES

1. Christopher, F.: Textbook of Surgery, Philadelphia, W. B. Saunders Company, 1950.
2. Edelmen, I. S., et al: Further observations on total body water. 1. Normal values throughout life span, Surg., Gynec. & Obst. *95:* 1 (July) 1952.
3. Ellison, E. H., Boles, T., and Zollinger, R. M.: Potassium deficits in surgical patients, Am. Surgeon *18:* 449 (May) 1952.
4. Elman, R., et al: Intracellular and extracellular potassium deficits in surgical patients, Ann. Surg. *136:* 111 (July) 1952.
5. Hardy, J. D., and Drabkin, D. L.: Measurement of body water; techniques and practical implications, J. A. M. A. *149:* 1113 (July 19) 1952.
6. Randall, H. T.: Water and electrolyte balance in surgery, Surg. Clin. N. America 445 (April) 1952.
7. Schloerb, P., et al: Measurement of total body water in human subject by denterium oxide dilution, J. Clin. Investigation *29:* 1296 (Oct.) 1950.
8. Seymour, W., and Irvin, C. W., Jr.: Severe potassium deficiency complicating paralytic ileus, J. South Carolina M. A. *48:* 178 (July) 1952.

MUCINOUS ADENOCARCINOMA OF THE URACHUS*

THOMAS G. ORR, JR., M.D. AND CREIGHTON A. HARDIN, M.D.

Kansas City, Kansas

Primary mucinous adenocarcinoma of the urachus is a very rare condition occurring predominantly in males in the middle to later age group. In 1931, Begg[1] could collect only 19 cases of this disease out of 44 cases of urachal neoplasms reported at that time. Since then, however, Begg[2] reported another case in 1936, and another in 1945, Hayes and Segal[4] reviewed the literature and recorded a total of 44 cases, and added 1 of their own. Rappoport and Nixon[7] added the forty-sixth case in 1946. Higgins[6] reported the forty-seventh case in 1946, Wessell and associates[8] the forty-eighth case, and Carreau and Higgins[3] the forty-ninth and fiftieth cases in 1952. Helwig[5] had studied 1 unreported case making a total of 51, to which we add the fifty-second.

The occurrence of an adenocarcinoma of the urachus resembling that often found in the colon is readily understandable when one remembers that embryologically both the urachus and colon are derived from the primitive hind gut, and are separated by the development of the urorectal septum. Hence, it is not difficult to suppose that a nest of certain cells may remain in the urachus, later to give rise to a neoplasm.

The most common presenting symptom of adenocarcinoma of the urachus is silent hematuria. A few patients may complain of dysuria or frequency. Lower abdominal discomfort may be present, and less frequently, glairy gelatinous material may be voided. This last sign is usually pathognomonic of mucinous urachal adenocarcinoma with invasion of the dome of the bladder. In only 1 case of those heretofore reported the tumor did not invade through the bladder wall. Hence, it may nearly always be visualized by cystoscopy and a specimen for biopsy may be taken to confirm the diagnosis.

The accepted treatment is radical resection of the tumor as soon as the diagnosis is established. However, laparotomy may be needed to confirm a suspected diagnosis and to determine the extent of the lesion and its resectability. The survival rate is very low, the majority of patients dying within two years after diagnosis and treatment.

CASE HISTORY

I. G., a 69 year old colored woman, was admitted to the University of Kansas Medical Center from the Out-patient Department on July 24, 1952, with a chief complaint of a tender mass in the lower abdominal midline of five weeks' duration. She reported that she had noted loss of energy for about the past three months prior to admission. Five weeks before her entrance to the hospital, she became aware of the gradual development of a tender swelling in the midline

* From the surgical service of the University of Kansas Medical Center, Kansas City, Kansas.

suprapubic area of the abdominal wall. She visited her local physician and received medical management of her hypertension which was causing some blurring of her vision. Apparently no direct therapy was applied to the lower abdominal problem. One week after the appearance of the abdominal mass, she began to experience urinary frequency, mild nocturia, and dysuria. Hematuria appeared only one week prior to hospitalization. Three weeks after the development of the swelling, the skin overlying the mass became reddened, slightly edematous, and more tender. She had lost about 20 pounds of weight since the onset of her illness.

FIG. 1. Appearance of suprapubic tumor mass prior to resection

Examination: This patient was an elderly appearing, well-developed, slightly underweight colored woman who did not appear to be acutely ill. Her blood pressure was 180/80. Examination of the abdomen revealed an elevated, reddened indurated area in the immediate suprapubic region measuring 12 cm. in diameter with moderate edema of the overlying skin (fig. 1). In the center of the mass, a circular area 5 cm. in diameter was soft and fluctuant. Tenderness was minimal. Pelvic examination showed a poorly defined anterior mass in direct continuity with the abdominal mass. The fundus of the uterus could not be identified, and the cervix was directed anteriorly, suggesting retrodisplacement of the uterus by the mass. No adnexal masses were noted. Sigmoidoscopy showed no evidence of involvement of the rectosigmoid colon, either intrinsically or extrinsically, and a barium enema showed no evidence of pathology in the remainder of the large bowel. On cystoscopy a neoplastic growth 6 cm. in diameter, could easily be seen, involving the dome of the bladder. A specimen for biopsy

was taken and reported as mucinous adenocarcinoma of the bladder. Intravenous pyelography did not show any dilatation of the ureters or renal pelves.

Laboratory Examination: On admission, her temperature was 98.6 F., red cell count 3,300,000 per cu. mm., white cell count 17,950 per cu. mm., hemoglobin 63 per cent and serology Kahn test four plus. Her blood chemistry was within normal limits.

Hospital Course: Through a curving transverse incision above the mass, the abdomen was explored. Her tumor mass did not involve the rectum or the internal genitalia. It extended from its area of presentation in the lower abdom-

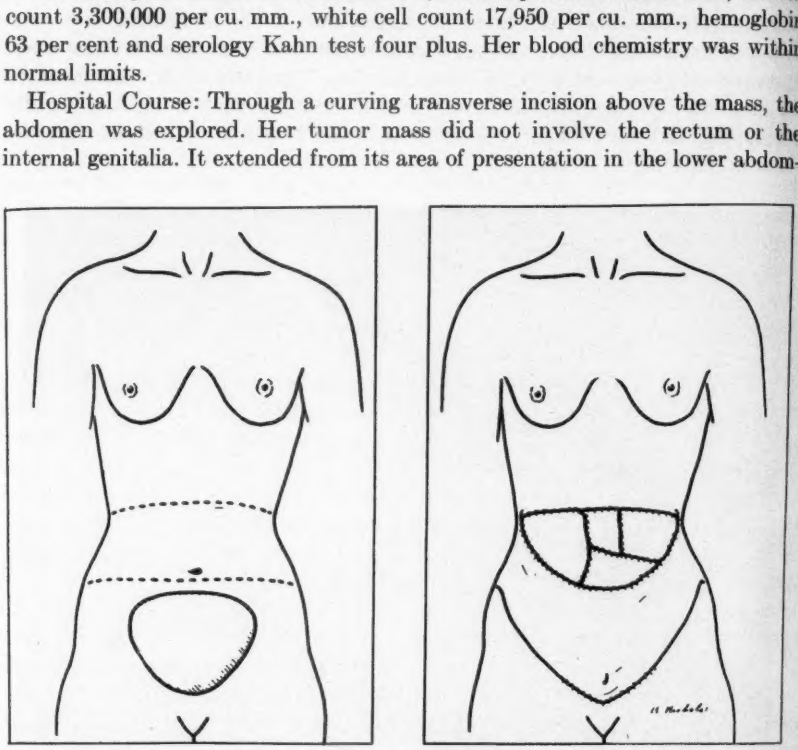


FIG. 2. Method of wound closure using large bipedicle graft and split thickness skin graft

inal wall down to and including an area 6 cm. in diameter of the dome of the bladder. A small area of sigmoid colon was adherent to the mass which was freed by excising about 3 square centimeters of serosa in the region, and an abscess cavity was opened in the process. All pus and necrotic material were aspirated as cleanly as possible, and the entire tumor was excised, including the lower abdominal wall and the dome of the bladder. The bladder was closed with chromic catgut. A Foley catheter was placed in the bladder and the retropubic space was drained. The peritoneum was then sutured to the pelvic brim and symphysis pubis which formed the lower margin of the wound. Reconstruction of the large defect in the abdominal wall was made by using a prosthesis of Fiberglas fabric (fig. 2). This was covered with a large bipedicle flap of skin and fat slid down from the upper abdomen and lower chest. The defect remaining above was covered with split skin grafts taken from the thighs and buttocks. Postoperatively her course was stormy, with persistant tachycardia and urinary drainage from

both catheter and retropubic drain. An ileus developed, necessitating intubation and parenteral alimentation. In view of copious urinary leakage in immeasurable quantities, accurate account of her fluid loss and electrolyte balance was impossible. Fluid and electrolytes were administered in a rather empirical fashion, aided as well as possible by following their concentration in the serum. Amino acids were also given, as were several transfusions of whole blood when they seemed to be indicated. On her fourth postoperative day she became febrile, and notwithstanding antibiotic and supportive therapy, her course was progressively downward until her death on her twelfth postoperative day. An autopsy was done, which showed grossly a vesicoperitoneal fistula, acute seropurulent fibrinous peritonitis, early bronchopneumonia, and generalized arteriosclerosis.

PATHOLOGIST'S REPORT

Two pieces of tissue were submitted for examination. The largest of these consisted of a portion of the abdominal wall with attached tumor mass and dome of the urinary bladder. The overlying skin was elliptical in shape and measured 10 by 16 cm. The skin was indurated peripherally and had a soft central area. It showed purplish discoloration. The superior portion of the specimen showed a pedunculated mass of tissue 14 cm. long, consisting chiefly of apparently normal adipose tissue, terminating inferiorly in a section of the dome of the bladder, 5.5 by 6 cm. The bladder mucosa was edematous and hyperemic with a thickened polypoid central area. Much thick mucoid material was present. A probe could be passed a distance of 8 cm. from an opening in the bladder section superiorly into the tumor mass.

The posterior surface of the mass was partially covered with peritoneum. About 7 cm. from the superior edge was an extraperitoneal mass measuring 7.5 by 5 cm., which appeared to join the urinary bladder. This mass was hard inferiorly and cystic superiorly. Over the posterior surface of the mass the peritoneum was hemorrhagic and showed an area of necrosis 1 by 4 cm. in size. At the superior portion of the necrotic area was a small hole from which mucoid material could be expressed. The large specimen weighed 549 grams. A second specimen consisted of an appendix epiploica which was found adherent to the main mass.

Sections taken at several locations in the tumor mass showed a chronic inflammatory reaction with fibrosis and many plasma cells, lymphocytes, and a few polymorphonuclear cells surrounding an area which was crowded with polymorphonuclear cells and papilliferous projections of mucus-forming tumor cells. Large collections of mucus with a few tumor cells were seen. The mucus-forming cells infiltrated muscle layers and in the bladder dome had formed papillary masses. Everywhere there was an accompanying acute and chronic inflammatory reaction. A section taken from the lines of excision of the bladder showed tumor cells. A section of the appendix epiploica did not show tumor invasion. The tumor cells were nested and showed large, ovoid, hyperchromatic nuclei and abundant acidophilic granular cytoplasm. For the most part these cells were arranged in cords, but in some areas they formed definite acini, and in others

tended toward papillary arrangement. A few mitotic figures were seen. No lining epithelium could be found.

Diagnosis: Mucinous adenocarcinoma of the urachus with acute and chronic inflammatory reaction and abscess extending to the subcutaneous tissue anterior to the tumor.

SUMMARY

A case of mucoid adenocarcinoma of the urachus with perforation of the abdominal wall and abscess formation is presented with a brief summary of the literature on the subject. We have found 50 such cases recorded. With the unrecorded case of Helwig and the case described here, the total is 52. Of those cases reported, only 9 showed a suprapubic mass as the presenting sign.

The therapy of choice is radical excision, with partial or total cystectomy. The prognosis is poor in this type of tumor. Few of the cases reported survived more than two years.

The interesting features of the case here presented are the development of a large fluctuant suprapubic mass and extensive involvement of the bladder with minimal urinary tract symptoms.

The primary cause of death in our case was an error in technic. In view of the urinary fistula, we believe we should have used suprapubic cystostomy and drainage.

REFERENCES

1. Begg, R. C.: Colloid adenocarcinoma of bladder vault arising from epithelium of urachal canal, Brit. J. Surg. *18:* 422 (Jan.) 1931.
2. Begg, R. C.: Colloid tumor of urachus invading bladder, Brit. J. Surg. *23:* 769 (April) 1936.
3. Carreau, E. P., and Higgins, G. A.: Diseases of urachus, Am. J. Surg. *84:* 205 (Aug.) 1952.
4. Hayes, J. J., and Segal, A. D.: Mucinous carcinoma of urachus invading bladder, J. Urol. *53:* 659 (May) 1945.
5. Helwig, F. C.: Personal communication.
6. Higgins, C. C.: Carcinoma of urachus, Urol. & Cutan. Rev. *50:* 4 (Jan.) 1946.
7. Rappoport, A. E., and Nixon, C. E.: Adenocarcinoma of urachus involving urinary bladder, Arch. Path. *41:* 388 (April) 1946.
8. Wessel, M. S., Kuritz, A. B., Burger, R. A., and Reagan, G. W.: Mucinous carcinoma of urachus invading the bladder, J. Urol. *67:* 523 (April) 1952.

SACROCOCCYGEAL TERATOMA (INCLUDING CASE REPORT)

KENNETH C. SAWYER, M.D., RICHARD E. ORR, M.D. AND M. J. BASKIN, M.D

Denver, Colo.

A teratoma is defined by Willis[5] as "a true tumor or neoplasm composed of multiple tissues of kinds foreign to the part in which it arises." By some authorities teratomas are considered to be a suppressed twin encapsulated within the

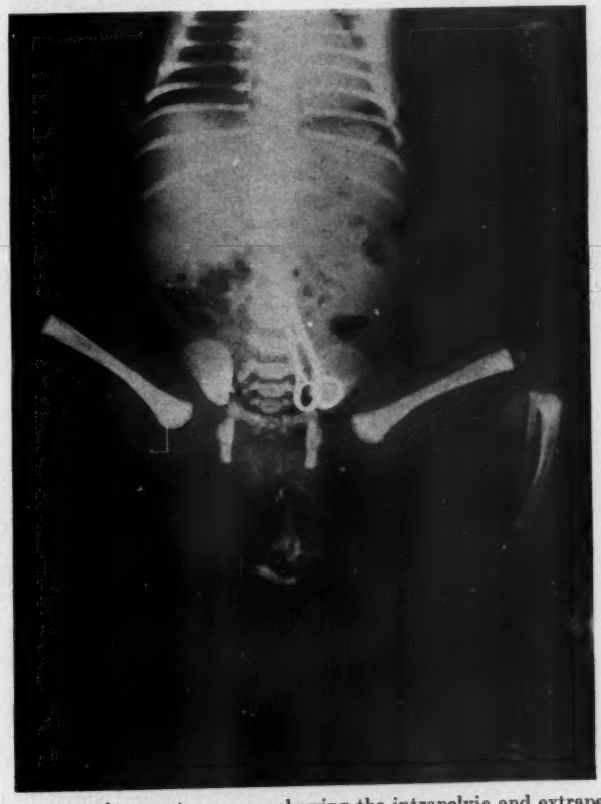


FIG. 1. Anteroposterior roentgenogram showing the intrapelvic and extrapelvic tumor in which areas of calcification are seen. A well formed long bone with epiphyseal ends is seen.

dominant partner, and by others as fragments of omnipotent embryonic tissue which have escaped the influence of the master organizer.

Teratomas are found most often near the dorsal body axis or in structures which have migrated from an embryonic axial or para-axial position. In order of

frequency, teratomas occur in the ovaries, testes, retroperitoneal tissues, anterior mediastinum, sacrococcygeal region, and at the base of the skull in the vicinity of Rathke's pouch. More rarely, they occur within the brain and neck. With the exception of testicular and intracranial teratomas, most of these tumors are benign. It should be emphasized, however, that malignant changes must be anticipated in about 15 per cent of sacrococcygeal teratomas. Signs of maturity

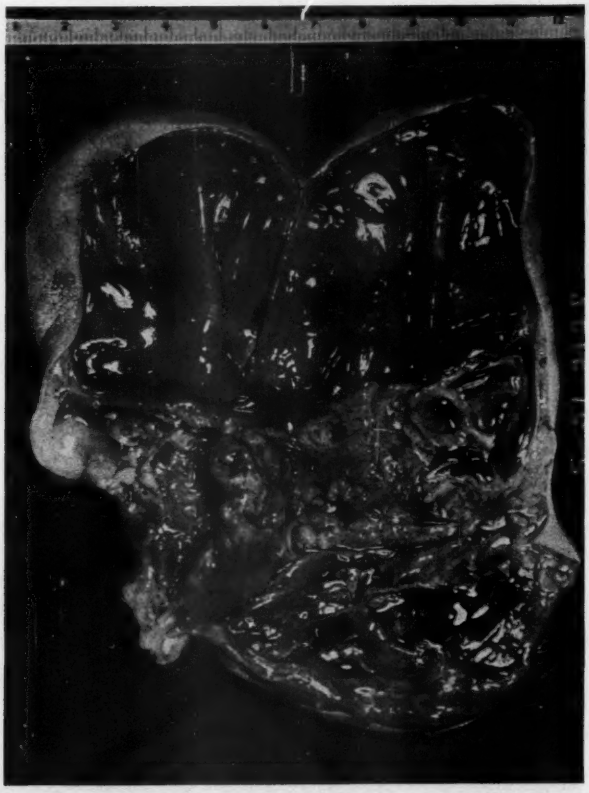


FIG. 2. The opened specimen which shows multiple cystic and solid areas

of the tumor tissue, such as bone or muscular twitching and peristaltic movements upon stimulation, indicate probable benignancy.

The sacrococcygeal teratoma is an uncommon tumor. Pack and Braund[4] reported an incidence of teratomas as about 1 per cent of all tumors at the Children's Memorial Hospital in Chicago. This tumor occurs most frequently in the female, the ratio being about 3 females to 1 male. It is particularly prone to include highly organized structures, such as digits, parts of intestines, and parts of the central nervous system, as well as skin and appendages. In a tumor of this

type meticulously described by Nicholson[3], there were three well-formed digits with metacarpals attached. In the case which we are reporting, the roentgenograms show a developing lone bone with a well defined epiphysis at each end (fig. 1).

The sacrococcygeal teratoma may occur dorsal to or in the sacrum and coccyx, but the great majority are on the ventral surface of these structures. All reported cases have been posterior to the rectum. The tumor may grow upward retroperitoneally into the pelvis or downward into the buttocks.

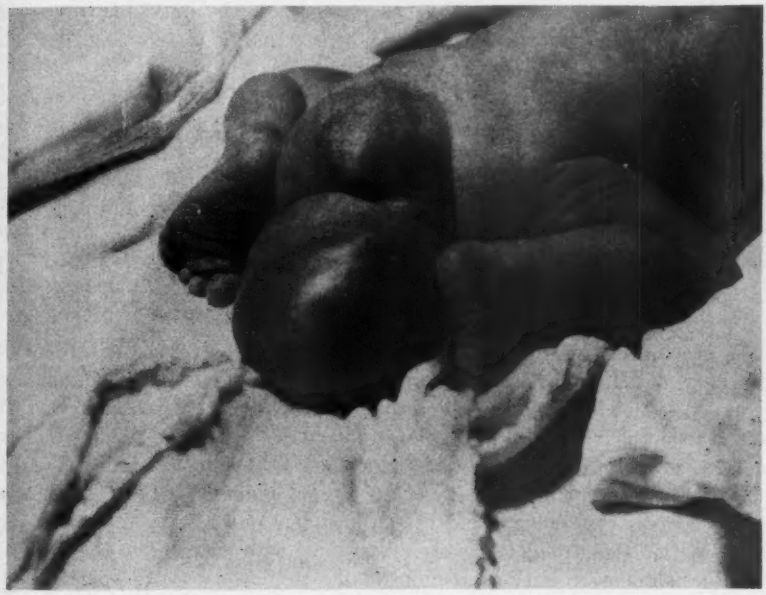


FIG. 3. A posterior view of the tumor before operation

About 70 per cent of these tumors are discovered at birth. Ewing[2] believes that one third of the fetuses with this tumor are *stillborn* and that 90 per cent of the remainder die in the *neonatal* period. The tumor may be so small as to be unnoticed or large enough to cause dystocia. Those tumors which grow upward into the pelvic cavity are liable to cause urethral and bowel obstruction.

As in our case, the tumor usually has both cystic and solid areas (fig. 2). Teratomas are covered by skin in which there may be ulcers and sinus openings. Bone or cartilage may be palpable in the tumor and muscular twitching or peristaltic motion may be observed after stimulation. The roentgenogram may demonstrate bone or teeth.

A meningocele has to be differentiated most often. As pointed out by De Veer and Browder[1], a meningocele is covered by a translucent membrane which, as a rule, can be shown to communicate with the spinal canal by bulging of the fon-

tanels on compression of the tumor and expansion of the tumor during crying. It is associated with a spina bifida and does not displace the rectum.

Other conditions such as chordoma, ependymoma, fibrosarcoma, chondroma, Ewing's tumor, giant cell tumor, and neurofibroma must be considered in the differential diagnosis.

CASE REPORT

B. G. B., a white female infant, was found at birth to have a tumor the size and general shape of a full term fetal head suspended between the thighs and attached by a broad base to the buttocks posterior to the anus (fig. 3). Delivery had been uncomplicated. Both bowel and urinary functions were normal. Examination revealed no other significant findings.

Operation was performed two days after birth under vinethene ether anesthesia. An incision was made around the sacrococcygeal mass. The tumor extended upward between the ischial tuberosities into the true pelvis, lying posterior to the rectum. While dissecting the tumor free from the hollow of the sacrum, a hiatus ½ cm. in diameter was found in the sacrum. A projection of dura, which was attached to the tumor, extended through this opening. The dural sac was closed with a suture ligature. The entire tumor was excised and the wound closed. The postoperative course was uneventful. The infant was discharged on the twelfth postoperative day. Subsequent healing was satisfactory.

The specimen weighed 98 Gms. and measured 12 by 6 by 8 cm. It was covered by skin containing scattered bluish areas and some growth of hair. The tumor was composed of two faintly demarcated spheroid masses roughly equal in size. The caudad lobe was cystic and the cephalad lobe was solid. The cystic portion contained a yellowish, bloody fluid and had a smooth, bluish white lining. The solid portion of the tumor contained bone, fat, and numerous small cystic areas. Microscopically, the general matrix of the tumor was a fatty fibro-connective tissue. Within the stroma lay many cysts, some with cartilage in the walls and lined by columnar ciliated epithelium of the respiratory type, whereas others were lined with a gastrointestinal type of epithelium. Bone, skeletal and smooth muscle were also seen. No malignant change was observed. The pathologic diagnosis was teratoma, sacrococcygeal, benign.

SUMMARY

We have included herein a brief discussion of sacrococcygeal teratomas which are uncommon clinical neoplasms. Included also is a concise case report of a 2 day old patient who was successfully operated upon at the Presbyterian Hospital in Denver.

REFERENCES

1. De Veer, J. A., and Browder, J.: Sacrococcygeal teratoma, Ann. Surg. *105:* 408 (March) 1937.
2. Ewing, J.: Neoplastic Diseases, Philadelphia, W. B. Saunders Company, 1940.
3. Nicholson, G. W.: Studies on tumor formation, Guy's Hosp. Rep. *87:* 46 (Jan.) 1937.
4. Pack, G. T., and Braund, R.: Sacrococcygeal teratoid tumor, Ann. Surg. *116:* 76 (July) 1942.
5. Willis, R. A.: Pathology of Tumors, London, Butterworth and Company, Ltd., 1948.

NEUROFIBROMA OF JEJUNUM WITH PERFORATION: A CASE REPORT

FREDERICK B. WARSHAUER, M.D.* AND ROBERT E. NELSON, M.D.†

Denver, Colorado

The following case report is presented because of the unusual occurrence of perforation in benign tumors of the small intestine.

Benign and malignant tumors of the small bowel occur with about equal frequency, and proper management is dependent upon accurate surgical and pathologic diagnosis. As a rule, simple local excision of benign tumors effects a cure, unless complicating pathology is present. On the other hand, adequate management of malignant tumors entails a radical surgical approach, often supplemented by postoperative irradiation, as in the lymphoma group.

The two clinical syndromes most often responsible for symptoms leading to the recognition of benign small bowel tumors are hemorrhage and obstruction. Hemorrhage is usually due to degeneration and necrosis of the tumor and may be massive and acute, or it may occur as intermittent episodes of tarry stools. Obstruction frequently occurs as a result of encroachment on the bowel lumen by annular or submucosal tumors, particularly in malignancies. Pedunculated tumors and occasionally intramural tumors, may provoke intussusception. Perforation and peritonitis occur frequently in the case of a malignant tumor, but our review of the American literature has failed to reveal a recorded instance of a benign small bowel tumor manifesting itself in this fashion (1–14).

CASE REPORT

H. C., aged 31, white man, was admitted to the Fort Logan Veterans Administration Hospital on Oct. 2, 1950 complaining of severe generalized cramping abdominal pain of 12 hours' duration. The pain had gradually increased in severity, became constant, and was accompanied by nausea and an urge to defecate.

The past history revealed occasional attacks of severe epigastric pain, during the previous two years persisting for several hours and recurring irregularly. Three weeks before admission he had noticed hard, tarry stools recurring daily for one week. Other past history revealed the appearance of multiple soft, painless subcutaneous nodules over the entire body during the past five years which had slowly increased in size. Tissue for biopsy taken from one of these subcutaneous nodules had been examined with unknown results. The patient's mother and sister have similar subcutaneous nodules.

Physical examination revealed a desperately ill, poorly nourished young white man in severe pain. The skin was pale and moist. The pulse was 110 and the temperature 100 F. The abdomen showed generalized tenderness and rigidity,

* Formerly Chief Surgical Resident, VA Hospitals, Fort Logan and Denver, Colorado.
† Senior Resident in Surgery, VA Hospital, Denver, Colorado.
From the Fort Logan Veterans Administration Hospital, Fort Logan, Colorado.

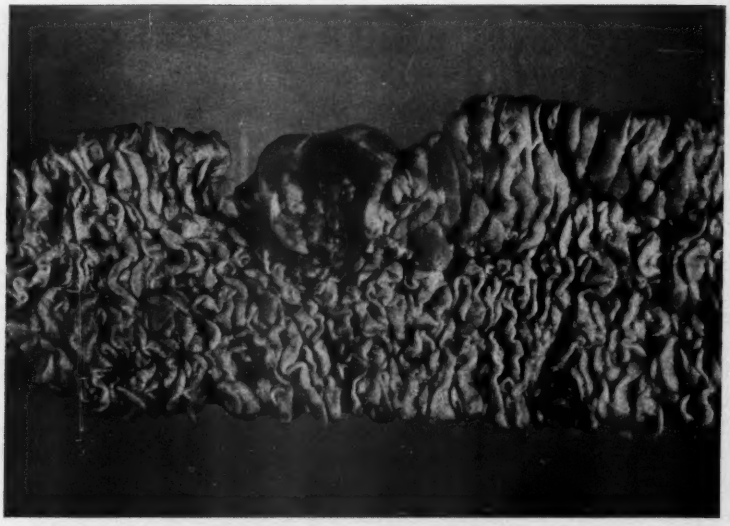


FIG. 1. Opened section of jejunum showing necrotic tumor near antimesenteric border

FIG. 2. Photomicrograph of bowel tumor showing typical areas of palisading

more pronounced on the right. Rebound tenderness was marked and peristaltic sounds were hypoactive. No masses or organs were palpable. Rectal examination revealed marked tenderness in the cul de sac. There were numerous soft, elevated

subcutaneous nodules measuring 0.3 by 1.5 cm. in diameter in the skin, especially over the back and trunk. An emergency hemogram revealed red blood cells 3,700,000 per cu. mm., hemoglobin, 11 Gm. per 100 cc. and white blood cells 23,000 per cu. mm. The differential count showed 95 per cent neutrophils and 5 per cent lymphocytes. Abdominal roentgenograms were not done.

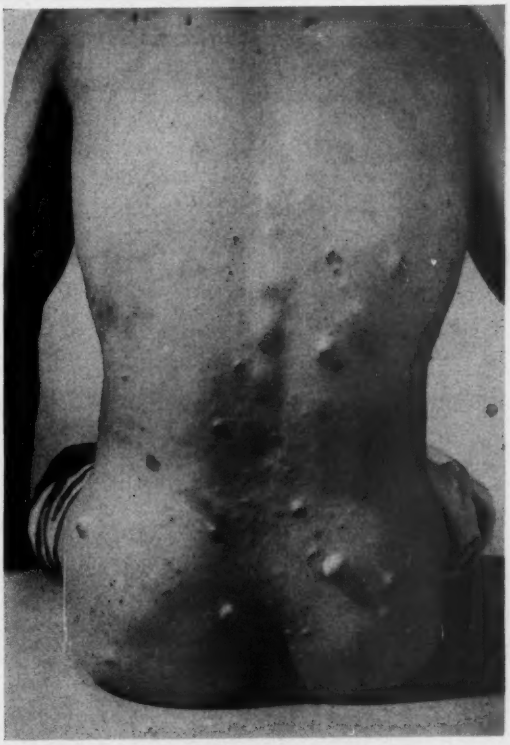


FIG. 3. Postoperative photography of patient showing numerous typical neurofibromata and cafe au lait spots.

A diagnosis of acute generalized peritonitis secondary to perforation of an abdominal viscus was made. Perforation of a peptic ulcer or of a gangrenous appendix was thought most likely to have occurred.

The patient was prepared for emergency operation, and under spinal anesthesia supplemented with intravenous sodium pentothal, the abdomen was entered through a high right rectus incision. A large quantity of purulent fluid filled the general peritoneal cavity. Examination of the stomach and duodenum revealed no abnormality. The appendix showed only secondary periappendicitis. The small bowel was explored from below upwards. Approximately 30 cm. distal to the ligament of Treitz a rubbery tumor 2 cm. in diameter was found on the antimesenteric border of the jejunum. In the center of the tumor, a perforation

2 mm. in diameter was found from which intestinal contents exuded (fig. 1). An intense inflammatory reaction involved the bowel and mesentery for a distance of 15 cm. in both directions. The mesentery was markedly edematous and contained numerous large, soft lymph nodes.

Thirty centimeters of the involved portion of bowel and attached mesentery were resected and an end to end anastomosis was made. The appendix was also

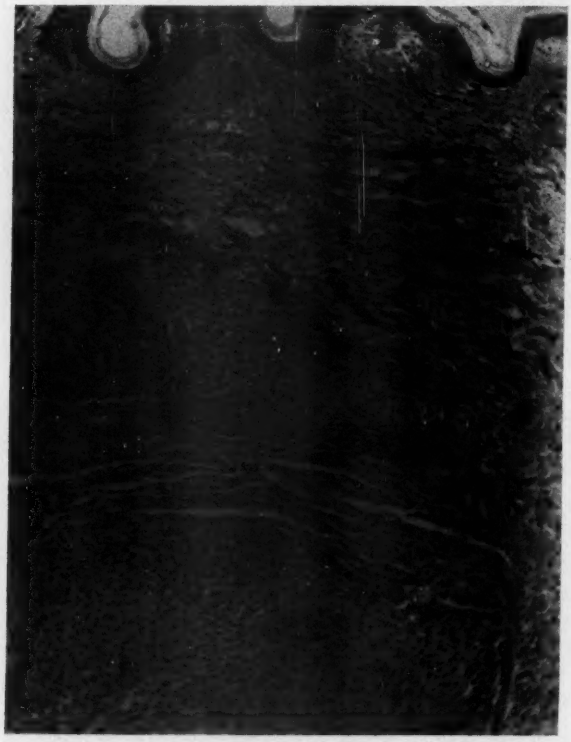


FIG. 4. Photomicrograph of subcutaneous neurofibroma. Compare histology with figure 2

removed. The patient received 1,000 cc. of whole blood and 500 cc. of plasma during the operative procedure. His immediate postoperative condition was good.

Pathologic examination of the resected specimen revealed a histologically benign tumor which was interpreted as probably a neurofibroma showing necrosis and perforation with surrounding inflammation of the jejunum and mesentery (fig. 2). The lymph nodes showed reactive hyperplasia. Cultures of the peritoneal fluid showed only nonhemolytic Staphylococcus albus.

The postoperative course was uneventful. Treatment consisted of continuous Wangensteen suction to an indwelling Miller-Abbott tube; large parenteral doses of penicillin and streptomycin; supplemental intravenous fluid and electro-

lyte therapy; and early ambulation. An additional 500 cc. of whole blood was administered on the first postoperative day. On the fourth postoperative day, the patient passed flatus freely and the Miller-Abbott tube was removed. Sutures were removed from the wound on the seventh postoperative day.

Two weeks following admission, two of the subcutaneous nodules described were removed for biopsy. Histologic examination revealed typical neurofibromas (von Recklinghausen's disease) (figs. 3, 4).

The patient was discharged from the hospital asymptomatic October 26, 1950. Follow-up examination one year later on October 1, 1951 showed a well-healed abdominal scar and no change in the subcutaneous neurofibromas. The patient had no complaints and had had no further abdominal pain or tarry stools.

COMMENT

The patient presented an acute surgical condition within the abdomen on admission, and differential diagnostic studies were deferred in favor of immediate surgical exploration. It is doubtful if abdominal roentgenograms without contrast medium would have made the diagnosis more definite.

At operation, the question of malignancy arose, since perforation of benign tumors of the small bowel is extremely rare. Accordingly, the entire area was resected, a procedure which was probably not too radical because of the severe inflammatory reaction incident to perforation of the bowel.

The several pathologists examining the tumor were not in complete agreement as to whether it represented a neurofibroma or the more common leiomyoma. Speculation as to the former diagnosis is intriguing because of the coexistence of the subcutaneous lesions.

In retrospect, the first symptoms which might have suggested the existence of the tumor were the episodes of epigastric pain and the melena. The pain could be explained on the basis of either localized jejunal spasm or of peritoneal irritation from inflammation incident to necrosis of the tumor. The melena was undoubtedly a result of hemorrhage due to necrosis and ulceration. None of the symptoms or signs was specific, and a diagnosis of duodenal ulcer was considered.

SUMMARY AND CONCLUSIONS

1. Although uncommon, small bowel tumors may present acute surgical emergencies in the form of hemorrhage, obstruction, or perforation of the intestine.

2. A case exemplifying perforation is presented.

3. Pathologic examination of the tumor suggests the probability of a neurofibroma associated with generalized neurofibromatosis.

4. To our knowledge, a similar case of a benign small bowel tumor causing perforation of the small bowel has not been reported in the American literature.

REFERENCES

1. Baker, H. L., and Halley, H.: Neurofibroma of small intestine with massive hemorrhage, Ann. Surg. *123:* 1067 (June) 1946.
2. Brekke, V. G.: Leiomyomata of jejunum, Harper Hosp. Bull. *6:* 129 (Sept.–Oct.) 1948.

3. Cattell, R. G., and Woodbridge, P. D.: Leiomyosarcoma of jejunum, S. Clin. North America *11:* 363 (April) 1931.
4. Foster, D. B. E.: Leiomyoma of ileum producing intussusception, Brit. M. J. *1:* 129 (Jan. 26) 1946.
5. Hanno, H. A., and Mensh, M.: Leiomyoma of jejunum, Ann. Surg. *120:* 199 (July-Dec.) 1944.
6. Klopp, E. J., and Crawford, B. L.: Leiomyoma of small intestine, Ann. Surg. *101:* 726 (Feb.) 1935.
7. Marshall, S. F., and Welch, M. L.: Leiomyoma of jejunum, New England J. M. *236:* 95 (Jan. 16) 1947.
8. Oberhelman, H. A., Condon, J. B., and Guzauskas, A. C.: Leiomyoma of gastrointestinal tract, Surg. Clin. North America *32:* 111 (Feb.) 1952.
9. O'Connor, J. M.: Fibromyoma of small intestine causing intussusception, M. J. Australia *2:* 491 (Oct.) 1946.
10. Raiford, T. S.: Tumors of small intestine, Arch. Surg. *25:* 122 and 321 (July and Aug.) 1932.
11. Rankin, F. W., and Newell, C. E.: Benign tumors of small intestine, Surg., Gynec. & Obst. *57:* 501 (Oct.) 1933.
12. Smith, O. N.: Leiomyoma of small intestine, Am. J. M. Sc. *194:* 700 (Nov.) 1937.
13. Weber, H. M., and Kirklin, B. R.: Roentgenologic manifestations of tumors of small intestine, Am. J. Roentgenol. *47:* 243 (Feb.) 1942.
14. Massachusetts General Hospital: Case report of obstruction of small intestine with leiomyomata, New England J. Med. *233:* 666 (Nov. 29) 1945.

LYMPHOSARCOMA OF THE DUODENUM ARISING IN THE PERI-AMPULLARY REGION.* A CASE REPORT

I. W. KAPLAN, M.D., L. TERRELL TYLER, M.D. AND S. L. CANALE, M.D.

New Orleans, La.

A primary malignant tumor of the small intestine may be classified as a carcinoma, a carcinoid or argentaffinoma, or a lymphosarcoma. Each type shows a predilection for a particular anatomic section of the small bowel.

Carcinoma occurs more frequently in the duodenum than elsewhere, while carcinoids are more likely to be found in the ileum.[6] The most common location for lymphosarcoma is the ileum and next in order is the jejunum; last in frequency is the duodenum. Reports by Raiford[9] and by Rankin and Chumley[10] bear out the fact that lymphosarcoma very seldom occurs in the duodenum. The extreme rarity of lymphosarcoma arising in the periampullary portion of the duodenum and simulating a primary carcinoma of the ampulla of Vater, or a primary carcinoma of the second portion of the duodenum, justifies the presentation of the following case.

CASE REPORT

M. B., a 73 year old white woman, was admitted to the Charity Service of Touro Infirmary on April 18, 1951, complaining of jaundice, epigastric pain after eating, and a weight loss of 45 pounds in the previous four months. The patient had apparently been in good health prior to October 1950, when she began experiencing pain in the right upper quadrant, epigastrium and left chest, which was most severe after eating. Shortly after the onset of these symptoms the patient began to feel weak and noticed a progressive loss of weight, amounting to 45 pounds in a period of four months. Two weeks before admission to the clinic, the patient developed jaundice with light stools and dark urine. The jaundice disappeared after four or five days only to recur three days prior to hospital admission. There was no history of tarry or bloody stools nor of change in bowel habits.

The past history was noncontributory, and there was no family history of cancer. The patient denied excessive use of alcohol and gave no history of exposure to toxic chemicals.

Physical examination on admission revealed an elderly white woman, who appeared chronically ill and somewhat lethargic. There was evidence of recent loss of weight. The temperature was 100.6 F., the pulse 80, the respirations 16, and the blood pressure 174/80. The skin and sclerae showed a marked icteric coloration. The chest was clear to percussion and auscultation except for some fine rales in the left lung base. The cardiovascular system was normal. The

* From the Department of Surgery, School of Medicine Louisiana State University and Touro Infirmary, New Orleans, La.

abdomen was soft and in the right upper quadrant there was a small, rounded, slightly tender mass, separate from the liver, which was thought to be the gallbladder. The liver edge was palpable 2 fingerbreadths below the costal margin and was smooth. There was a fullness in the epigastrium and there was some question as to whether or not a small mass was palpable. Other physical findings, including rectal examination, were normal.

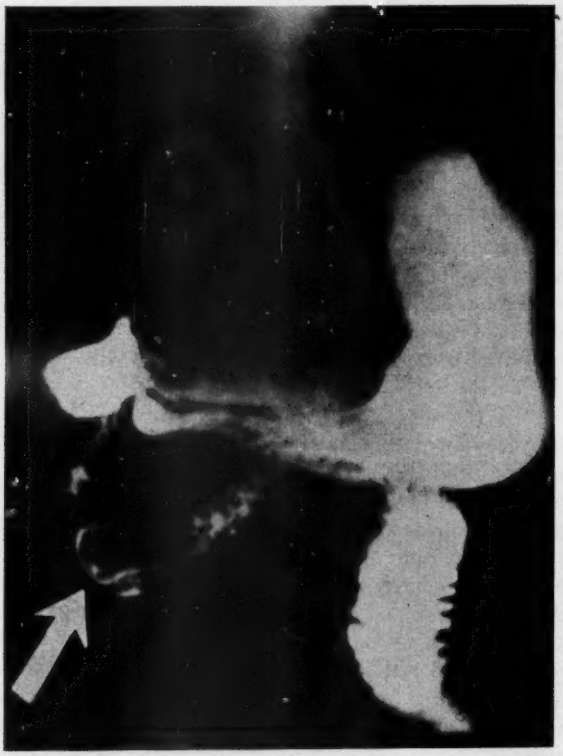


FIG. 1. Gastrointestinal series showing polypoid lesion causing filling defect at junction of descending and transverse portion of the duodenum.

Laboratory tests, made on admission, gave the following results. There were 4,020,000 red blood cells per cu. mm., with a hemoglobin of 11.6 Gm. per 100 cc. The white blood cell count was 8,850 per cu. mm., with neutrophils 76 per cent, lymphocytes 16 per cent, eosinophils 7 per cent, and monocytes 1 per cent. The urine was amber in color and had a specific gravity of 1.006. Chemically, it showed a trace of albumin and 1 plus sugar; microscopically, it was negative. The nonprotein nitrogen was 33. The blood Wassermann was negative. The blood sugar was 200 mg. per 100 cc. Liver and biliary function tests showed a prothrombin time of 88 per cent of normal, a serum bilirubin of 7.4 mg. per 100

cc., negative cephalin flocculation test, a thymol turbidity of 2, alkaline phosphatase 18.2 B units, and a serum protein of 5.4. Stools were light yellow in color and did not contain occult blood, parasites, or abnormal fat.

Roentgenographically the chest was normal. The gallbladder did not visualize after a double dose of dye and no stones could be demonstrated. A barium enema was negative. A gastrointestinal roentgenographic series showed the esophagus

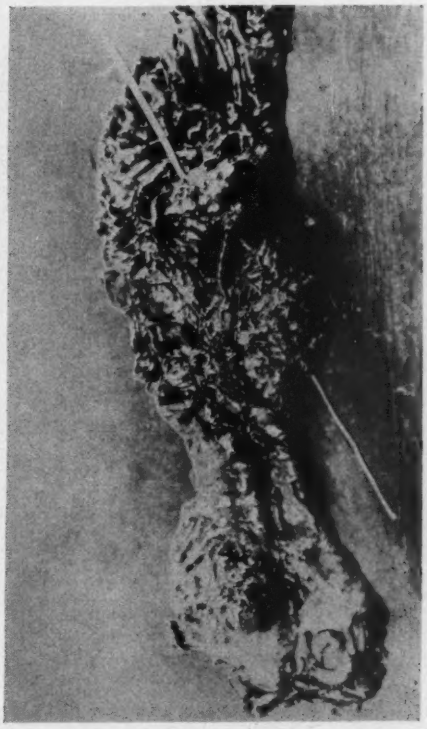


FIG. 2. Excised surgical specimen with probe through ampulla of Vater, passing through center of tumor.

and stomach to be normal. The duodenal bulb appeared to be indented by an extrinsic band but no other abnormality was seen in this area. In the transverse portion of the duodenum (fig. 1), at about the junction of the descending and transverse portions, a filling defect was noted, which had the appearance of a polypoid lesion, apparently confined to the duodenum itself. It was the opinion of the roentgenologist that, although this finding might be the result of extension from a neoplasm of the pancreas, the defect was more suggestive of a primary tumor of the duodenum or ampulla of Vater. The stomach and duodenum emptied normally at the end of six hours.

The patient's temperature on admission was 100.6 F. but was normal on the

second hospital day and remained normal until the day of operation. Preoperatively, she was given transfusions, vitamin K and daily infusions of glucose. Because the blood sugar had been reported elevated on two occasions (200 mg. per 100 cc. on admission and 185 mg. per 100 cc. on April 20, 1951), she was given insulin on a sliding scale, but required only a total of 30 units of regular insulin in the seven days of the preoperative period. The jaundice continued to

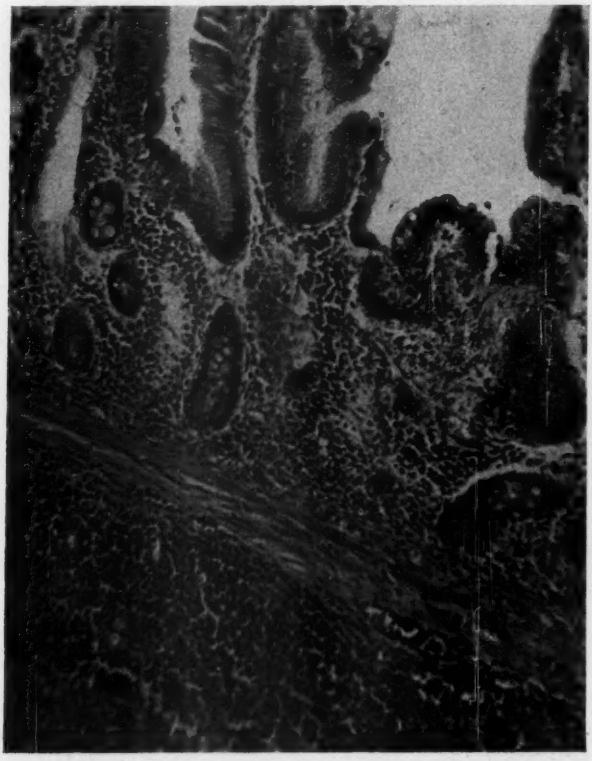


FIG. 3. Low power photomicrograph showing tumor composed of small round, dark staining lymphoid cells having no resemblance to epithelium.

increase. The preoperative diagnoses considered were (1) carcinoma of the head of the pancreas, and (2) carcinoma of the duodenum or of the ampulla of Vater.

An operation was done on April 26, 1951. The abdomen was entered through a high right paramedian incision. The liver was moderately enlarged, its surface was smooth and there was no evidence of cirrhosis or metastases. The gallbladder was markedly enlarged and the common duct was dilated to about 3 cm. in diameter. The spleen and stomach were normal. On further exploration of the duodenum and pancreas, a firm rounded mass about 3 to 5 cm. in diameter was palpated in the second portion of the duodenum at the junction of the descending

and transverse portions. It was at first impossible to ascertain whether the mass was in the duodenal lumen or in the head of the pancreas. However, after mobilization of the duodenum, the mass seemed to be confined to the duodenum. There was no evidence of fixation to surrounding structures. Therefore, the tumor was resected. This involved the performance of a partial pancreatectomy, complete duodenectomy, and a choledochojejunostomy, pancreaticojejunostomy, gastrojejunostomy, and cholecystostomy.

FIG. 4. Photomicrograph of figure 3 in high power showing detail of cytology of lymphoid cells.

The excised specimen consisted of a segment of duodenum, measuring 30 cm. in length which included the pyloric ring, and the head of the pancreas, which measured 5 by 5 by 2 cm. In the region of the ampulla there was a fungating circumscribed mass (fig. 2), firm and resilient in consistency and measuring 4 by 4 by 2 cm. in its greatest dimensions. A probe passed through the neoplastic mass entered the common duct which continued within the substance of the pancreas. The remainder of the duodenal mucosa revealed no significant gross abnormality. Microscopically, the sections (figures 3 and 4) of the tumor showed

a neoplasm arising from the wall and submucosa of the duodenum in the region of the ampulla. The tumor was composed of small, round, dark-staining lymphoid cells having no resemblance to epithelium. The epithelium overlying the ampulla was not involved in the malignant process. The pathologic diagnosis was lymphosarcoma of the duodenum arising in the ampulla of Vater.

For the first three days the postoperative course was fair, the urinary output being adequate and the fluid and electrolyte balance being maintained. The patient was alert, responded well, and her general condition was good. However, on the fourth postoperative day the urinary output became scanty, bilateral basal atelectasis developed, and the patient became semicomatose. She died on the fifth postoperative day.

The summarized anatomic diagnoses at autopsy were: (1) lymphosarcoma of the duodenum in the region of the ampulla of Vater; (2) recent resection of the duodenum, head of the pancreas and terminal common bile duct, with choledochojejunostomy, pancreaticojejunostomy, gastrojejunostomy, and cholecystostomy, all anastomoses being sound and patent with no evidence of leakage; (3) jaundice; (4) left lower lobe atelectasis; (5) left hydronephrosis due to stenosis of the left pelvo-ureteral junction; (6) passive congestion of the liver, and (7) cholelithiasis.

DISCUSSION

Malignant tumors of the small intestine have been reported by various observers[1, 8, 9] as ranging in incidence from 3 to 6 per cent of all neoplastic gastrointestinal lesions. Raiford[9] reported that, of the 776 malignant gastrointestinal tract tumors which he analyzed in 1932, only 38, or 4.9 per cent, occurred in the small intestine. Of this group of 38, 21 were diagnosed as lymphosarcomas, and these 21 lymphosarcomas showed a striking predilection for the terminal ileum. In all of the 21 cases, with the exception of one, the tumors were located in the terminal 100 cm. of the ileum. It is interesting to note that this one exception occurred in the middle third of the duodenum opposite the papilla of Vater, a very similar location to that of the lymphosarcoma here described.

The most common malignant tumor of the small intestine is carcinoma, usually located in the second portion of the duodenum, and often clinically indistinguishable from carcinoma of the extrahepatic bile ducts, common duct, and head of the pancreas.[4, 8]

The general symptoms of a malignant growth of the duodenum are[4] loss of appetite, nausea and vomiting, weakness, secondary anemia, and gaseous eructation. Late in the disease a palpable mass may be found. All of the symptoms become progressively worse as the disease advances. Should ulceration develop, the patient may run a low-grade fever, and the vomiting may become more frequent and the vomitus may be red or coffee ground in color. There may be tarry stools. If the growth involves the ampulla, jaundice and clay colored stools develop. Often there is a remission of the jaundice due to sloughing of the tumor but it recurs after several days or weeks, as it did in our case. It is the obstructive type of jaundice that brings these patients to exploratory operation.

Roentgenologic study early in the process may fail to reveal any intrinsic disease of the duodenum. Later it may show a filling defect or a narrowing of the lumen of the duodenum.

In our case the malignant tumor was so located that the signs and symptoms prior to operation rendered it indistinguishable from the malignant tumors more commonly found in this region. Since tumors of the lymphoid series do not metastasize as readily as do true connective tissue tumors or carcinomas, they offer a better prognosis than do the more common carcinomas of the head of the pancreas, and as good, or a better, prognosis than do primary carcinomas of the ampulla of Vater. Prognosis may depend more on early diagnosis than on the type of the tumor.

Radical resection of the entire duodenum and head of the pancreas is now being frequently done.[2, 11] The results are much better when the growth is confined to the periampullary region. Many modifications of the original Whipple procedure have been reported.[11] The procedures of Hunt, Waugh, Orr and Pearse involve a minimum of anastomoses and are the methods most commonly employed. After using several of these methods for resection of carcinoma of the head of the pancreas and ampulla of Vater and, in one instance, for a primary carcinoma of the duodenum we have adopted the Waugh[11] operation as it seems to be one of the simplest and easiest to do.

SUMMARY

A case of periampullary lymphosarcoma producing intermittent jaundice, weight loss, fever and anemia is presented.

REFERENCES

1. Bockus, H. L.: Gastroenterology, Philadelphia, W. B. Saunders Company, 1943–1946 (3 vols.).
2. Cattell, R. B.: Pancreatoduodenal resection, New England J. Med. *232:* 521 (May 10) 1945.
3. Cattell, R. B., and Colcock, B. P.: Tumors of small intestine, S. Clin. North America *27:* 644 (June) 1947.
4. Dixon, C. F., Lichtman, A. L., Weber, H. M., and McDonald, J. R.: Malignant lesions of duodenum, Surg., Gynec. & Obst. *83:* 83 (July) 1946.
5. Ewing, J.: Neoplastic Diseases, ed. 4, Philadelphia, W. B. Saunders Company, 1940.
6. Likely, D. S., Lisa, J. R., Stitch, M. H., and Stein, H. D.: Primary malignant disease of small bowel, Arch. Int. Med. *82:* 206 (Aug.) 1948.
7. Lingley, J. R.: Non-obstructing malignant tumors of small bowel, Am. J. Roentgenol. *36:* 902 (Dec.) 1936.
8. Mayo, C. W.: Malignancy of small intestine, West. J. Surg. *48:* 403 (July) 1940.
9. Raiford, T. S.: Tumors of small intestine, Arch. Surg. *25:* 122 (July) and 321 (Aug.) 1932.
10. Rankin, F. W., and Chumley, C. L.: Lymphosarcoma of colon and rectum, Minnesota Med. *12:* 247 (May) 1929.
11. Waugh, J. M., and Clagett, O. T.: Resections of duodenum and head of pancreas for carcinoma, Surgery *20:* 224 (Aug.) 1946.

CHOLEDOCHODUODENAL FISTULA: REPORT OF TWO CASES DUE TO DUODENAL ULCER

CHARLES L. COGBILL, M.D. AND HAROLD P. ROTH, M.D.

Cleveland, Ohio

It is not common for the biliary duct system to be visualized during upper gastrointestinal roentgenography. Occasionally, there is a fistula between the upper gastrointestinal tract and the gallbladder and barium passes through it into the gallbladder and then on into the biliary ducts. Even less frequently, the common duct is filled with barium directly. This can be due to some abnormality causing the sphincter of Oddi to be patulous[14] or to a fistula between the common duct and the duodenum.

A number of cases have been reported in which it was believed that barium passed into the common duct through an abnormally patulous sphincter. In 1 case it was thought that the sphincter had been dilated by passage of a gall stone.[12] In another it was considered that surrounding pancreatitis had caused the sphincter to be incompetent.[1] In a third group of cases, the sphincter of Oddi had actually been sectioned surgically.[7]

The formation of a fistula between the common duct and the duodenum has been reported in a number of cases. Waggoner and Le Mone[15] reviewed 819 cases of internal biliary fistula and found that 19 per cent of them were choledochoduodenal. These fistulas have been attributed to carcinoma of the duodenum, erosion of a gallstone from the common duct into the duodenum[9] or to erosion of a duodenal ulcer into the common duct. The formation of a fistula from the common duct to the duodenum is not common in calculous biliary tract disease. Thus, Judd and Burden[5] found only 1 case of fistula between the common duct and duodenum in 153 cases of fistulas between the biliary tree and gastrointestinal tract demonstrated at operation. Roth, Schroeder, and Schloth[3] reported only five fistulas between the common duct and duodenum in 1029 patients found to have gall stones at autopsy.

A fistula found between the common duct and duodenum, is most commonly due to peptic ulcer, according to Borman and Rigler.[3] Fourteen of the 16 cases that they reviewed either had an ulcer by history or clinical findings. The total number of cases of choledochoduodenal fistula due to peptic ulcer reported is small. Garland and Brown[4] in 1942, found reports of 24 cases of choledochoduodenal fistulas. In 19 of these cases, the cause was believed to be peptic ulcer. A number of these cases, however, were not verified by operation or postmortem examination. Koberle[6] could find only 8 reported cases in the literature up to 1938 when he accepted those cases proved by autopsy or operation. He added 2 cases of his own. We have been able to find 8 more cases reported since that time.[2, 4, 8, 10, 11, 12, 13]

From the Surgical Service and Medical Service, Gastroenterology Section, Veterans Administration Hospital, and Western Reserve University School of Medicine, Cleveland, Ohio.

Two cases showing visualization of the common duct during gastrointestinal roentgenographic examination have been seen at this hospital, bringing the total to 20. Both of our cases have been operated upon and the preoperative diagnosis of duodenal ulcer confirmed. Since so few proved cases of choledochoduodenal fistulas are recorded in the literature we believe that our 2 cases should be reported.

Case 1. R. T., aged 34, white man laborer, was admitted to the hospital on April 26, 1951 complaining of dull epigastric pain of five years' duration. The pain usually came on about a half hour after meals and was temporarily relieved by taking baking soda. Frequently the patient was awakened at night by the pain and would have to take soda for relief. He had one episode of hematemesis and melena early in the course of his illness; this was so severe that he fainted and was brought to the hospital. Since the onset of his illness, he has never been on any prolonged diet nor has he taken any medicine except soda; he has sought medical aid only on the one occasion that he bled. His epigastric distress became progressively worse until the time of his admission. There was no history of jaundice, chills, or fever. He has had many family difficulties since discharge from the Army and is a very nervous, tense individual. Physical examination revealed a thin, anxious-appearing man who looked older than 34 years. The general physical examination otherwise was not remarkable.

Hemogram and urinalysis were normal; serum bilirubin was 0.62 mg. per cent and routine blood chemistry determinations were normal. Gastric analysis after administration of histamine revealed a peak of 104 clinical units of free hydrochloric acid, with a total acid of 122 clinical units. Gastrointestinal roentgenograms (figs. 1 a & 1 b) revealed a deformed duodenal bulb and a communication between the duodenum and the common bile duct. The cystic duct also was visualized and barium was seen in the gallbladder.

Hospital Course: The patient was placed on a progressive Sippy regime and, after a short time, stated that his symptoms were completely relieved. Operation, however, was considered advisable and was performed on May 17, 1951. The gallbladder and common duct appeared normal; there was a duodenal ulcer posteriorly, about 3 cm. from the pylorus. Operative cholangiograms (fig. 2) revealed some narrowing of the distal end of the common duct which was attributed to be due to an extrinsic inflammatory process in the duodenum. A partial gastric resection with posterior Hofmeister-type gastrojejunostomy was done; the duodenum was cut across proximal to the ulcer and inverted. The patient did well and was discharged from the hospital 11 days after operation. At follow-up one year after operation, the patient reported that he felt very well and had no specific complaints.

Case 2. L. J. S., aged 52 white man, was first admitted to the hospital on Aug. 25, 1950, complaining of nightly vomiting of one month's duration and right paraumbilical pain for the past four years. This pain was relieved by applying heat locally but was not relieved by the ingestion of milk and cream. Shortly after the onset of the pain four years before admission, he had had gastrointestinal roentgenograms which were interpreted as showing a peptic ulcer. Soon after this,

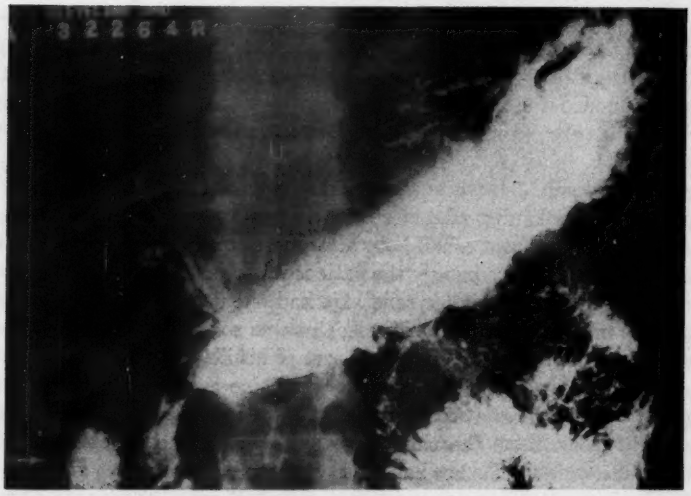


FIG. 1a. (R. T.) Anteroposterior roentgenogram showing barium in stomach, duodenum, and biliary duct system. Arrow points to barium in gallbladder.

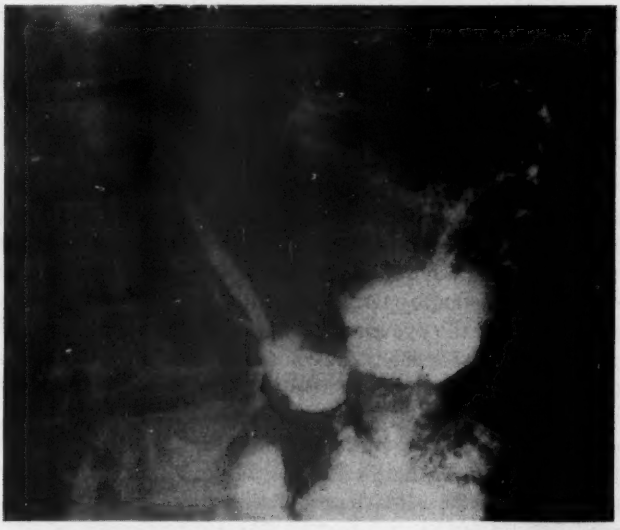


FIG. 1b. (R. T.) Oblique roentgenogram showing barium in stomach and deformed duodenal bulb. The biliary duct system, which is well outlined by barium, is seen communicating with the duodenum.

an operation was performed elsewhere. A fibrosed appendix was removed and the patient was told he had gallbladder disease but his gallbladder was not removed. There was no history suggestive of cholangitis. Physical examination revealed

a well developed and well nourished 52 year old man, who was not acutely ill. There was a well healed old right rectus incision. There was slight tenderness in the right abdomen near the umbilicus. Otherwise the physical examination was not remarkable.

The urinalysis and hemogram were normal, as were the serum bilirubin, cephalin flocculation, blood urea nitrogen, chlorides, CO_2, serum amylase, serum

FIG. 2. (R. T.) Operative cholangiogram. There is some extrinsic narrowing of the distal end of the common duct with medial displacement. The proximal portion of the common duct and intrahepatic biliary tree are within normal limits.

proteins, and the albumin-globulin ratio. On gastric analysis with histamine, the highest free hydrochloric acid was 75 units, with a total of 94. The chest roentgenogram was not remarkable. The gallbladder roentgenographic series showed that the gallbladder visualized faintly; calculi could not definitely be made out. Gastrointestinal roentgenography (figs. 3 a & 3 b) revealed marked deformity of the duodenal bulb with partial obstruction. On the five hour roentgenograms, there was about 50 per cent retention of barium in the stomach. A definite abnormal communication between the duodenum and common bile duct was present, the common duct and some of the hepatic branches being visualized. There was

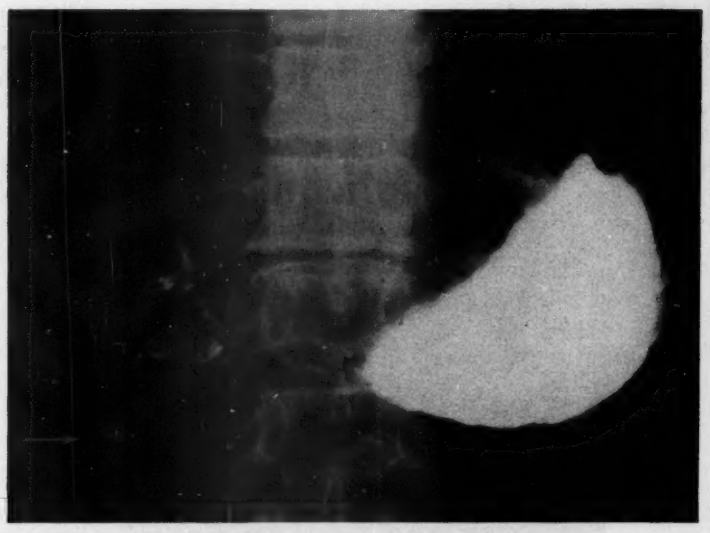


FIG. 3a. (L. J. S.) Five hour anteroposterior roentgenogram showing barium in stomach and biliary tree. The duodenal bulb is not outlined. Arrow points to barium in gallbladder.

FIG. 3b. (L. J. S.) Oblique roentgenogram showing barium filled biliary duct system communicating with the duodenum. At no time could the duodenal bulb be well outlined.

also a pool of barium overlying the right posterior twelfth rib which was interpreted as being barium in the dependent portion of the gallbladder.

Hospital Course: The patient was put on a Sippy regime with daily aspirations of the stomach. His pain was relieved and he was allowed to go home. He continued to have gastric retention and, later, he was recalled for operation. On Dec. 21, 1950, he was operated upon through a right rectus abdominal incision.

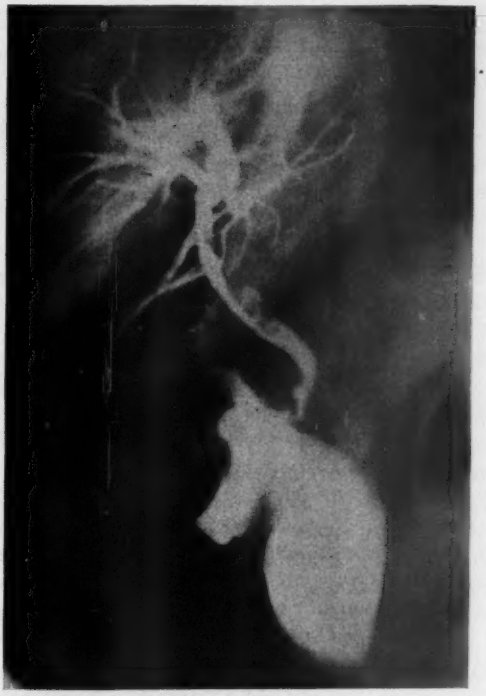


FIG. 4. (L. J. S.) Operative cholangiogram following exploration of the common duct. This is a normal cholangiogram.

His gallbladder appeared somewhat thickened, but otherwise it was normal; the common duct appeared normal. There was a large duodenal ulcer with considerable inflammatory reaction surrounding it. The common duct appeared to be drawn into the side of the duodenum in the region of the ulcer.

Operative cholangiograms revealed a stellate negative shadow in the common duct. Subsequently, after cholecystectomy and exploration of the common duct, repeat cholangiograms showed a normal common duct without stones (fig. 4). Stones were not found in the common duct. A vagotomy and posterior isoperistaltic gastrojejunostomy were then done. The pathologic report of the gallbladder was chronic cholecystitis. The patient's postoperative course was uneventful. A postoperative gastrointestinal roentgenographic examination on

Jan. 9, 1951, showed a normal-functioning gastroenterostomy. The afferent loop of the gastroenterostomy was not visualized nor was the choledochoduodenal fistula. At follow-up three months after the operation, the patient had gained 26 pounds and was working regularly. Eighteen months after the operation, he returned to the hospital complaining of dull abdominal pain to the right of the umbilicus of three months duration. There was no history suggestive of cholangitis. Liver function studies were normal. He showed free acid on examination of his overnight secretions but no increase in free acid after administration of insulin. Gastrointestinal roentgenograms revealed a functioning gastroenterostomy without evidence of marginal ulcer. No barium passed through the pylorus and the fistula was not visualized. In the hospital, on bed rest and an ulcer regime, his symptoms disappeared and he was discharged at his request. It was thought possible that he had developed either a stomal or recurrent duodenal ulcer and arrangements were made for continued follow-up.

DISCUSSION

In the case of R. T., it was possible to do a partial gastric resection, cut across the proximal duodenum and get an adequate closure of the duodenal stump above the ulcer, leaving it in place. Gastrointestinal roentgenograms taken on this tenth postoperative day revealed a normal functioning gastroenterostomy. The fistulous communication between the duodenum and the biliary tree was not visualized and the biliary tree contained neither barium nor gas. The patient has had no subsequent symptoms.

Cholecystectomy was done in the case of L. J. S. because of cholangiographic evidence of common duct stone, although there were no demonstrable stones in the gallbladder itself. Upon common duct exploration, however, no stones were found and a second cholangiogram, taken on the operating table through a T tube, did not disclose the radiolucent area previously seen. This was then interpreted as some sort of an artefact. Due to the proximity of the ulcer to the common bile duct, it was considered that there would be danger of injury to the common duct in doing a satisfactory gastric resection and hence a vagotomy and posterior gastroenterostomy were decided upon. These were accomplished without difficulty.

The clinical picture observed in these cases is not distinctive and there was nothing definite to suggest the presence of a choledochoduodenal fistula prior to its demonstration by the gastrointestinal roentgenologic examination. One patient, R. T., had fairly typical ulcer symptoms, and the other, L. J. S., had symptoms of ulcer and gastric retention. Other authors have also commented upon the absence of any special symptomatology suggesting this complication in the cases that they studied.[2, 5]

The rarity of ascending cholangitis in the presence of a communication between the upper gastrointestinal tract and the biliary tree has also been pointed out by others[2, 6] and confirmed here. Only in an autopsied case reported by Marchiafava and cited by Koberle[6] in which an ulcer had cut the common duct in half, was there an ascending cholangitis noted.

A definite demonstration of the ulceration into the common duct could not be made at operation in these cases even though the duodenal ulceration itself was shown. This is true of other reported cases. It is, accordingly, possible that the papilla was rendered incompetent by scarring as a result of ulceration, although this would seem less likely than direct ulceration into the duct.

In one of our patients, the gallbladder was only faintly visualized after repeated roentgenologic examinations. This gallbladder was found to be the seat of mild chronic cholecystitis on microscopic examination. In the other patient, the oral cholecystogram could not be completed because of lack of cooperation of the patient. The gallbladder appeared normal at operation.

There is little discussion of the treatment of this condition in the literature and, indeed, the number of cases reported is so small that no one individual has had a chance to observe more than 1 or 2. Considering only those cases caused by duodenal ulcer, the question arises as to whether operations should be advised in every case of choledochoduodenal fistula or should it be reserved for those cases presenting, as well, other indications for operation such as bleeding, obstruction, and intractability. It is our belief that operation is indicated in a majority of these cases because of the difficulty in obtaining permanent satisfactory healing in a posterior penetrating ulcer by medical means, and the possibility of cholangitis due to the fistula. In those cases in which surgical therapy is decided upon it should be so designed that the twofold purpose of causing the ulcer to heal and shortcircuiting the passage of food away from the fistula site is accomplished. Simple gastric resection leaving the ulcer and fistula in situ would permit healing of the ulcer and would also leave the fistula, whether it closed or not, in a defunctioned segment of bowel. Hence, even if the fistula did not close, the danger of ascending cholangitis should be minimal.

Tate and Shaw[13] believe that the procedure of choice is partial gastrectomy and partial duodenectomy with closure of the fistula and cholecystoduodenostomy, fearing that the ulcer and fistula might not heal, or, if they did heal, the subsequent scarring might lead to obstruction of the common duct at the site of the fistula. Other reports have not called attention to these complications and we have wondered if the extensive procedure outlined above is necessary. Should common duct obstruction occur following simple partial gastrectomy, another operation would be required.

SUMMARY

Two cases of choledochoduodenal fistula due to duodenal ulcer are reported and roentgenograms presented.

Both cases were treated surgically with satisfactory results to date.

REFERENCES

1. Beal, F. C., and Jagoda, S.: Injection of bile ducts with barium, J. A. M. A. *76:* 1483 (May 28) 1921.
2. Beekhuis, W. H.: Uber spontane innere gallenfisteln, Acta. radiol. *24:* 38, 1943.
3. Borman, C. N., and Rigler, L. G.: Spontaneous internal biliary fistula and gallstone obstruction, Surgery *1:* 349 (March) 1937.
4. Garland, L. H., and Brown, J. W.: Roentgen diagnosis of spontaneous biliary fistulae, especially those involving the common duct, Radiology *38:* 154 (Feb.) 1942.

5. Judd, S., and Burden, V. G.: Internal biliary fistula, Ann. Surg. *81:* 305 (Jan.) 1925.
6. Koberle, F.: Beitrag zur Kenntnis der auf Ulcusbasis entstandenen inneren Gallenfisteln, Arch. f. klin. Chir. *192:* 572, 1938.
7. Kohler, B.: Du passage du contenu intestinal dans les voies biliarires apres papillotomie transduodenale, Acta. Chir. Scandinav. *77:* 155, 1935–6.
8. Lebon, J., and Vergoz, C.: Perforation d'un ulcere duodenal dans le choledoque, Mem. Acad. de chir. *74:* 455 (June) 1948.
9. Naunyn, B.: A Treatise on Cholelithiasis, translated by A. E. Garrod, London, the New Sydenham Society, 1896.
10. Niviere, J.: Sur un cas d'ulcus duodenal perfore dans le choledoque. Opacification des voies billiares au cours de transit gastro-duodenal, J. de radiol. et electrol *28:* 405, 1947.
11. Plattner, H. C.: Contribution au diagnostic radiologique des fistules biliare internes, J. de radiol. et electrol *27:* 505, 1946.
12. Puestow, C. B.: Spontaneous internal biliary fistula, Ann. Surg. *115:* 1043 (June) 1942.
13. Tate, R. C., and Shaw, H.: Choledochoduodenal fistula, Am. Surgeon *18:* 443 (May) 1952.
14. Venable, J. F., and Briggs, P. J.: Visualization of bile ducts after an opaque meal, Guy's Hosp. Rep. *79:* 123 (Jan.) 1929.
15. Waggoner, C. M., and LeMone, D. V.: Clinical and roentgen aspects of internal biliary fistulas, Radiology *53:* 31 (July) 1949.

EDITORIAL

SHOULD THE RADICAL OPERATION FOR CARCINOMA OF THE PANCREAS BE EXTENDED?

An interesting comparison may be drawn between Socrates' interpretation of justice and present day surgical treatment of cancer of the pancreas. Socrates insisted that justice was desirable for it was not only in itself good, but in addition, it was productive of good. Pancreaticoduodenectomy is desirable because it is a good operation by means of which a cancer, primary in the head of the pancreas, can be removed. That this radical operation, however, is productive of good may certainly be questioned. Today it is common knowledge among physicians and surgeons that the results of pancreaticoduodenectomy have been far from productive of good.

Well over 100 patients whose pancreatic cancer has been treated by resection are available for study. It is doubtful whether a single one of these with a tumor arising from the acinar tissue of the gland has survived five years. Only 2 or 3 whose tumor was of ductile origin have passed the five year mark. The average survival time of those neglecting to contribute to the operation's postoperative mortality is from 12 to 15 months, a period barely twice that obtained by palliative decompression of the billiary tract.

Where then should the surgeon of today turn in his treatment of pancreatic cancer. On the one hand there is available an operation whereby malignant tumors of the head of the pancreas can be removed, oftentimes without leaving any obvious cancer behind. The postoperative mortality is no longer prohibitively high. Yet on almost every hand can be heard expressed the opinion that the operation should be abandoned because its rate of salvage is so low. A year or so ago Dr. Allen O. Whipple, the originator of the operation, considered its future so bleak that he was forced to label his operation as little more than palliative. Such pessimisms as these do not appear consistent with progressive surgical practice. Neither are they good nor are they productive of good.

Where to turn to improve the record? Parsons has pointed out the importance of including the entire common bile duct and the lower common hepatic duct in the operation. Cattell has suggested the results of the operation might be improved were the entire pancreas removed rather than just the head. Within the past year it has been demonstrated at the New York Hospital that the portal and superior mesenteric veins can be resected by a two-stage procedure. Parsons and Person have both recorded patients in whom the portal vein was resected in one-stage where it had presumably been obstructed long enough for adequate collaterals to have developed between the portal and systemic venous circulations. Recently McDermott has shown that the portal vein can be resected in one-stage provided this is preceded by a venous shunt fashioned between the superior mesenteric vein and the vena cava. Furthermore it is more than reasonable to predict that it will only be a matter of time before a superior mesenteric artery

which is invaded by tumor will be resected and the blood supply returned to the gut either by end to end suture or through an autogenous venous or a preserved arterial graft. Here then can be seen the history of radical cancer surgery repeating itself in terms of malignant pancreatic tumors. It is becoming more and more apparent that the original limits of pancreaticoduodenectomy need no longer be observed.

With these exhibits at hand it appears unlikely that pancreaticoduodenectomy will be abandoned, at least not for some time. The problems, though great, can be surmounted today and are far too challenging to go unmet. It is obvious that efforts are being, and will continue to be, made to extend the usefulness of this operation. The outcome of these endeavors cannot be determined at this time, but will have to await the accumulation of a far greater experience than is yet available.

New England Center Hospital CHARLES G. CHILD, III, M.D.
Boston, Massachusetts